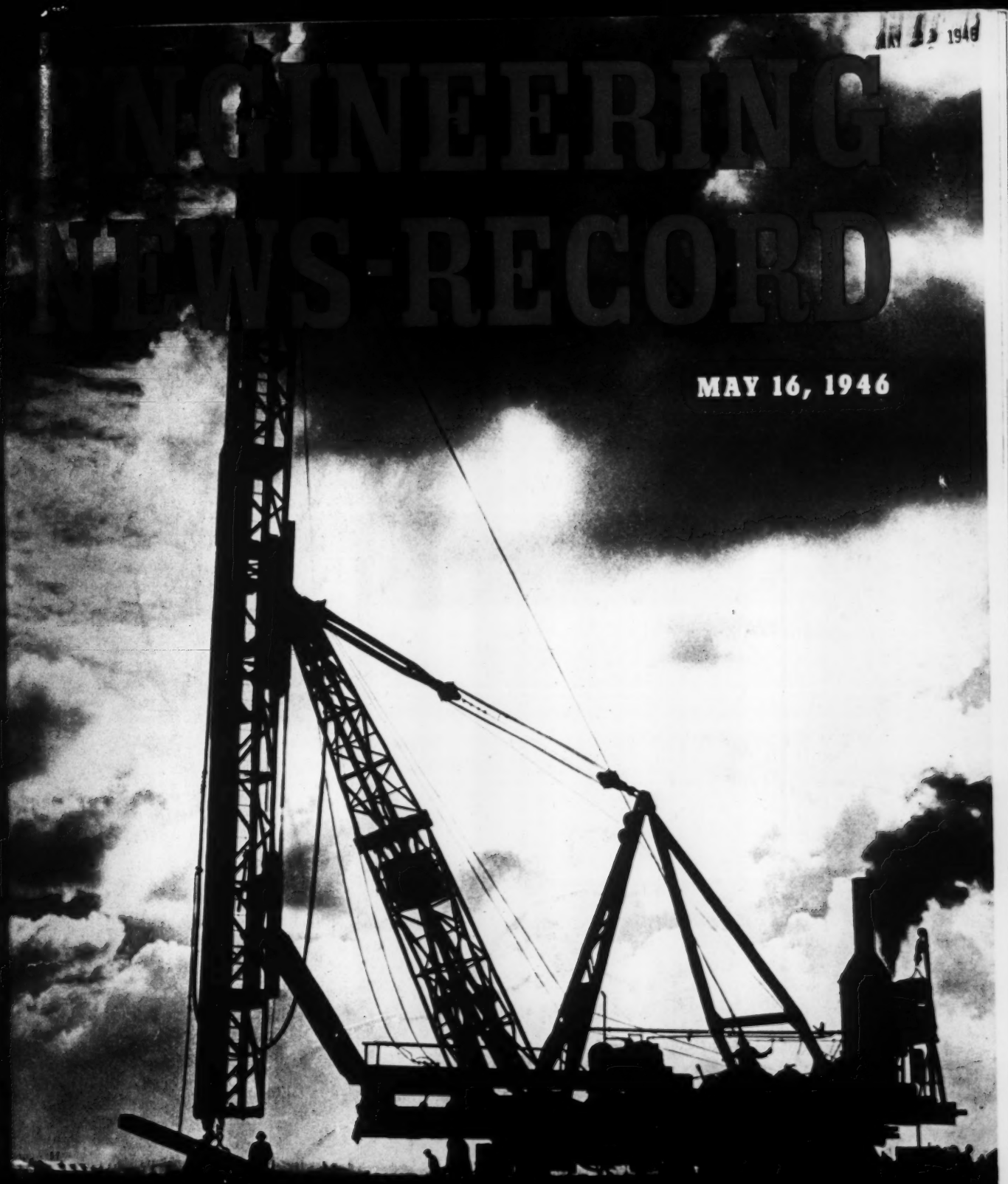
MAY 16 1946

ENGINEERING NEWS-RECORD

MAY 16, 1946



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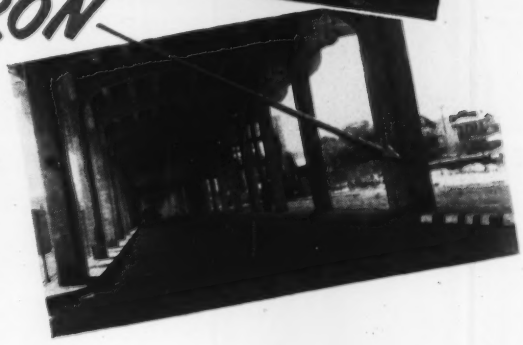

In the program of grade crossing elimination on the Long Island Railroad from Rockaway to Far Rockaway, in the City of New York, several potential trouble-spots where corrosion might strike—lamp standards, conduit, and downspouts in the stations, and railing along the right of way—were safeguarded with wrought iron. Byers Wrought Iron 3-inch galvanized pipe was used for the downspouts, Byers standard black wrought iron pipe, 1¼ and 1½-inches, for the lamp standards. Varying sizes of Byers Wrought Iron pipe were furnished for the conduit and fence.

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MAY 16, 1946

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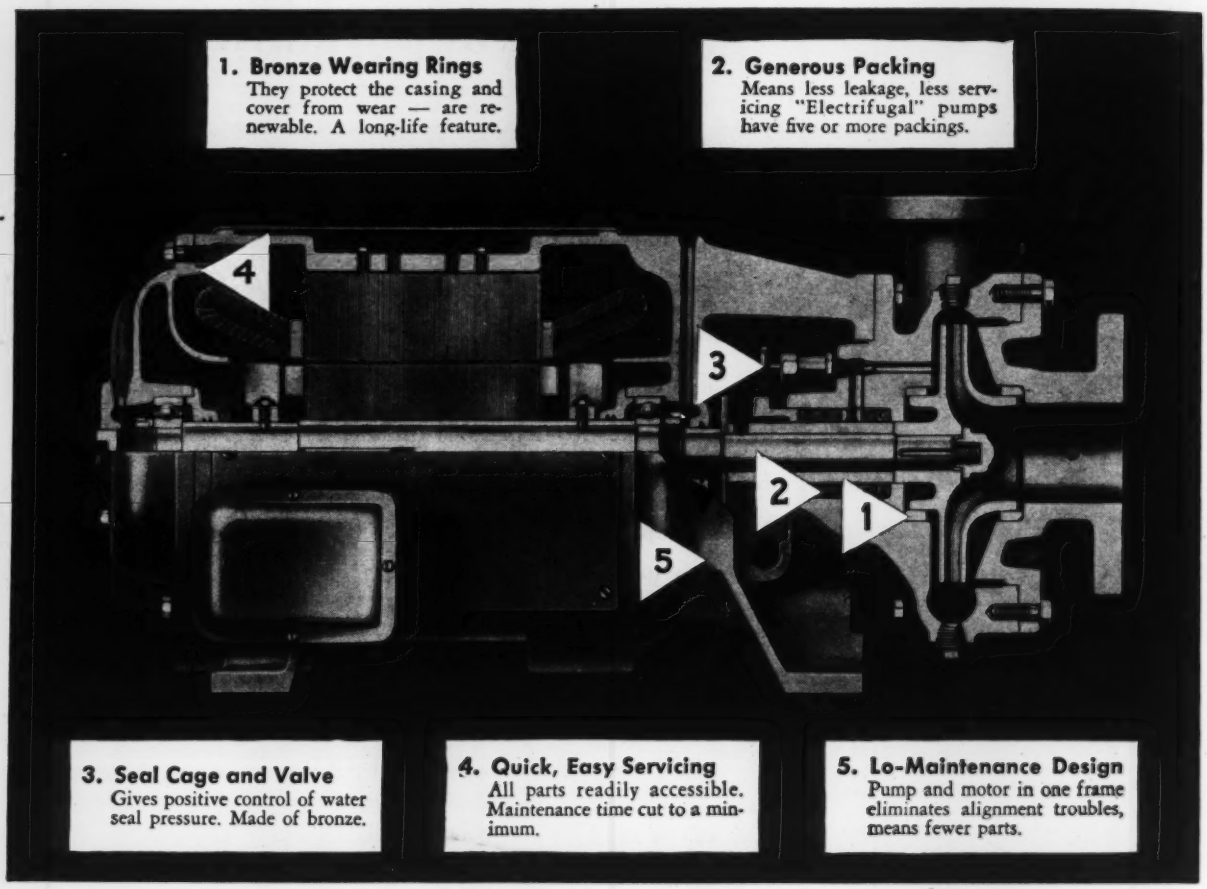
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News of the Week

ENGINEERING NEWS-RECORD • MAY 16, 1946 • VOLUME 136 • NUMBER 20

Bill is signed authorizing $1 billion for airports

New law authorizes appropriation of $500,000,000 of federal aid for 7-yr. construction program—Aid for planning and land purchase also provided in new measure

A bill (S. 2) authorizing but not appropriating $500,000,000 in federal aid to states and local groups for airport construction during the next seven years has been approved by both branches of Congress and signed by the President. When combined with local matching funds the total construction program will become about $1 billion. The federal aid for any one year is limited to $100,000,000. This authorization becomes effective July 1.

Apportionment of the money

Five percent of the $500,000,000 or $25,000,000 is to be used for administrative expenses by the Civil Aeronautics Administration, which will administer the act. Of the $475,000,000 balance, 75 percent or $356,250,000 will be apportioned to the states on an area-population basis, giving equal weight to a state's population and area as compared with the population and area of the entire country. An accompanying table shows state apportionments of the $356,250,000 under this formula.

The remaining 25 percent of the $475,000,000 portion or $118,750,000 will be used as a discretionary fund by the CAA administrator in carrying out the national airport plan regardless of states lines. This plan, which the CAA submitted to Congress in November, 1944, calls for construction of over 3,000 new fields and improvement of about 1,600 existing airports (see *ENR* Dec. 7, 1944, vol. p. 725 for table).

The bill also provides $20,000,000 in federal aid for airport projects in the territories, divided roughly as follows: $10,000,000 for Alaska, $5,000,000 for Hawaii and $5,000,000 for Puerto Rico. The CAA administrator is granted certain discretionary powers with reference to allowing more than 50 percent federal contribution on territorial projects. Also, government departments or agencies may sponsor projects in national parks, forests and national-monument areas with government land to be provided free when available and under certain conditions.

An appropriation of $3,000,000 for engineering, planning and surveys by the CAA is also authorized.

Small fields are favored

While the larger cities won their battle to have the federal funds channeled directly to local sponsors, the bill as signed gives special consideration to the need for smaller airports. The law gives the CAA administrator a discretionary power so as to permit allocations of federal funds in amounts less than 50 percent for larger airports (Classes 4 and 5) and further protects the program from excessive grants to larger cities through a Congressional review and veto procedure. On the other hand, the full 50 percent federal grant is mandatory on Class I, II and III, the smaller airport projects.

The $500,000,000 authorization is to remain available during the life of the bill which is seven years. This provision protects those states that do not expend the full amount appropriated each year.

Following the federal highway program precedent, the bill contains a preference clause for public-land states. States in which more than 5 percent of the land is federally owned may receive up to a maximum of 62½ percent in federal funds. Larger airports in these states also come under this clause.

Aids in land acquisition

The bill also provides that the federal government may participate up to 25 percent in land acquisition and condemnation costs with the CAA administrator given authority to determine what is a reasonable price for the costs involved. Local sponsors are not granted authority to use federal condemnation laws as the bill was finally written. Condemnation proceedings must be initiated under state laws, or under grants of power by states to local units.

(*Continued on page* 61)

FEDERAL AID FOR AIRPORTS

Alabama	$6,874,077	Nevada	6,663,841
Arizona	7,388,661	New Hampshire	1,213,277
Arkansas	5,766,751	New Jersey	6,089,775
California	18,697,066	New Mexico	7,889,865
Colorado	7,663,436	New York	21,156,642
Connecticut	2,607,586	North Carolina	7,938,360
Delaware	481,764	North Dakota	5,033,080
District of Columbia	901,112	Ohio	11,774,192
Florida	6,018,106	Oklahoma	7,281,468
Georgia	7,695,709	Oregon	7,189,743
Idaho	5,634,509	Pennsylvania	16,064,883
Illinois	14,007,502	Rhode Island	1,036,577
Indiana	6,776,014	South Carolina	4,400,329
Iowa	6,750,695	South Dakota	5,410,591
Kansas	7,285,422	Tennessee	6,434,388
Kentucky	6,230,312	Texas	24,433,789
Louisiana	6,057,620	Utah	3,749,013
Maine	3,103,678	Vermont	1,052,284
Maryland	3,087,175	Virginia	6,027,989
Massachusetts	6,326,381	Washington	6,367,666
Michigan	10,541,544	West Virginia	3,998,144
Minnesota	8,732,048	Wisconsin	7,554,042
Mississippi	5,766,437	Wyoming	6,109,791
Missouri	9,226,226		
Montana	9,428,452	Total	$356,250,000
Nebraska	6,332,068		

Shortages of waterworks materials may hinder housing, AWWA warns

Low inventories and delays in manufacturing will prevent service extensions—Missouri River development favored and opposed

Objectives of the national emergency housing program cannot possibly be reached unless restrictions on the production of waterworks materials are "forthrightly" cleared away declared Harry E. Jordan, secretary of the American Water Works Association, at the 66th annual conference of that group, which was held in St. Louis last week.

"This clearing away", said Mr. Jordan, should not be done by the subsidy route, but by a reorientation of OPA price control policies that hamper every manufacturer". He characterized the situation today as one in which the waterworks industry is moving toward a complete tailspin in its ability to carry on its normal functions, let alone expansion.

On the basis of a survey covering water systems in cities over 10,000 population—which represents 75 percent of the buying power of the industry—the lack of supplies and materials was described as extremely serious. The amount of pipe, fittings, valves, hydrants, meters and service line materials and fittings on hand varied from 7½ to 11 weeks normal supply. Moreover, manufacturers of these materials report that from 14 to 17 weeks must elapse between the time orders are received and products can be shipped.

It cannot be overlooked, said Mr. Jordan, that the waterworks industry's part in any national housing program is one of the keys to its success.

Coal strike causes apprehension

Lack of materials was not the only matter over which apprenhension was expressed at the meeting. All of the delegates were greatly concerned over maintenance of water service in the face of the continuing nationwide soft-coal strike, and some of them were called out of sessions to cope with emergency conditions at home.

Details of the strike negotiations as well as other news were flashed on the teletype visual ticker service, which was featured at the *Engineering News-Record* booth in the exhibits room of the convention.

One of the major attractions at the technical sessions, which were held on May 6-10, was the appearance of Brig. Gen. Lewis A. Pick, colorful Army Engineer officer who built the Ledo Road in Burma and is co-author of the Pick-Sloan plan for development of the Missouri River basin. Now serving as division engineer of the Missouri River Division, Corps of Engineers, General Pick described the benefits that will be derived from the joint Army Engineer-Reclamation Bureau program now getting underway.

Benefits to water supply

"No plan for development of river basin resources in this country can be completely comprehensive and all-embracing without due consideration of the needs of municipal water supply and sanitation," said General Pick, "and the plan for developing the Missouri River basin fully envisages these requirements."

Taste and odor control is one of the most difficult problems in treating Missouri River water for domestic consumption, said General Pick. At low-water stages the water is hard because it carries a heavier concentration of dissolved minerals; also, there is more algae to produce disagreeable tastes and odors. And the formation of sandbars at such periods may endanger supply by diverting water from intakes of municipal and industrial plants.

Controlled release of water from the proposed reservoirs not only will insure more adequate water during periods of normal low flow, but the increased flow will simplify the problem of removing taste and odor as well as reduce the cost of required treatment chemicals.

The system of reservoirs and channel improvements, as planned, will also protect domestic and industrial water supplies during flood periods, said General Pick. Dangers inherent in flood flow in the Missouri River, which include increased silt load, higher turbidity, higher concentration of organic matter, and possible damage to intakes and pumping plants will be reduced appreciably by the river development program.

One of the critical problems facing St. Louis during recent years has been that of protecting its water supply structures during floods. During the 1943 and 1944 floods the Howard Bend plant serving St. Louis was saved only after the most exhaustive battle and by the narrowest margin. When the flood crest was reached there was only 7 in. of freeboard between the city and an appalling disaster, concluded General Pick.

Further attention was focused on the Missouri River plan by W. W. Horner, consulting engineer of St. Louis and president of the American Society of Civil Engineers who told the waterworks men that:

"From the viewpoint of a taxpayer and an engineer I am unable to find that the proposed Missouri Valley development plan meets the test which I consider necessary to prove that it is in the best public interest."

Such a test, said Mr. Horner, would require (1) an inventory of the water needs of the basin in each of the distinctive functional fields of water development and control; (2) visualization of alternate possible methods of securing economically justified projects and determining which alternate is the best; (3) an economic study of the costs and benefits of the best plan in each functional field; and (4) a comparison and coordination of the best plans.

Unified administration proposed

To Mr. Horner it appeared to be in the public interest that the execution of projects under such a "best" plan should be assigned to federal and possibly state agencies having a primary responsibility and experience in the various functional fields. Under the present program each of the agencies involved (the Army Engineers and the Bureau of Reclamation) feels that it should approach its task with a distinct unwillingness to sacrifice any features of its plan, and a very definite tendency to have the greatest possible part of the plan fall within its field of responsibility.

At the very least, said Mr. Horner, the states should be represented by engineers experienced in the field of water development and in the application of engineering economics. He recommended th establishment of a special council to function as a coordinator or referee. On this council would be representatives from the federal agencies involved, a representative of the public from each of the ten states in the Missouri River basin and possibly five additional civilians appointed by the President.

Industry and river pollution

Further discussion on the theme of utilizing rivers in the public interest was provided by Abel Wolman, professor of sanitary engineering, The Johns Hopkins University, Baltimore, who took industry to task for dumping its wastes into waterways without treatment and without regard to downstream uses of the flow.

Such practice, said Mr. Wolman, represents carelessness at best and complete disregard of responsibilities at its worst. Where industry ever acquired the right to discharge wastes into waterways is not established legally and it certainly cannot be considered good "housekeeping".

(*Continued on page* 59)

Interior appropriation bill provides $103 million for construction work

Budget recommendations cut by nearly 50 percent—Bureau of Reclamation fund reduced due to unexpended funds and lack of materials—Work of other bureaus also curtailed

In reporting out the appropriation bill (H.R. 6335) for the Department of the Interior for the next fiscal year, which begins July 1, the Appropriations Committee of the House of Representatives has recommended $103,043,530 for engineering and construction work. This amount is only about 50 percent of the $243,063,250 recommended by the Bureau of the Budget. Lack of building materials and the fact that large previous appropriations will be carried over to next year were listed as reasons for trimming its recommendations so drastically.

The Bureau of Reclamation received the largest reduction. Its request of $155,590,000 was trimmed to $65,973,040 for engineering and construction activities. Other engineering and construction money in the bill as now being debated in the House includes: National Park Service, $11,750,000; Bonneville Power Administration, $9,000,000; Bureau of Indian Affairs, $4,919,125; Geological Survey, $4,735,465; Southwestern Power Administration, $3,198,000; and Alaska, $3,017,900.

How bureau fund is earmarked

A breakdown of the money for the Bureau of Reclamation shows that $13,442,490 has been earmarked for the Reclamation Fund. This total includes the following items: General investigations, $3,250,000; Provo River project, Utah, $1,345,040; Anderson Ranch Dam, $1,234,475; Payette Division of Boise project, $1,115,660; Lugert-Altus project, Oklahoma, $901,900; Tucumcari project, New Mexico, $753,605; Palisades project, Idaho, $650,410; Riverton project, Wyoming, $650,410; and San Luis project, Colorado, $650,410.

Also included in the Reclamation Fund are Roza Division of the Yakima project, Washington, $624,650; Deschutes project, Oregon, $563,685; Minidoka project, Idaho, $433,605; Rio Grande project, New Mexico and Texas, $360,675; Heart Mountain Division of the Shoshone project, Wyoming, $346,885; Kendrick project, Wyoming, $216,800; Klamath project, Oregon and California, $216,800; Willwood Division of Shoshone project, Wyoming, $58,970; Sun River project, Montana, $41,625; and Ogden River project, Utah, $26,885.

An amount of $38,590,830 is authorized for the general fund of the Bureau of Reclamation. This money will permit continuation of construction on the Columbia Basin project, $13,008,145; and the Central Valley project, $10,840,120. An amount of $6,504,075 is provided for the Colorado-Big Thompson project; $6,504,070 for Davis Dam; $867,210 for the Hungry Horse project in Montana, and $867,210 for the Gila project in Arizona.

The sum of $10,312,684 is provided for initial work in the Missouri River basin and $2,384,825 for additional work on the All-American Canal.

National Park funds

For the construction of roads and trails, the National Park Service will receive $4,250,000. An amount of $7,500,000 for the continuation of construction of parkways is also included.

The Geological Survey is provided with a little more than half of its budget request of $8,000,000. Of the $4,735,465 approved for this bureau, $2,626,120 is for topographic surveys, and $2,109,345 for gaging streams.

Power Administration fund cut

One of the deepest cuts in the recommendations of the Bureau of the Budget concerned the $23,323,000 recommendation for the Southwestern Power Administration. Twenty-three million dollars was to have been earmarked for new construction, while the $323,000 was for operation and maintenance. This fund was cut by the committee to $3,198,000 for new construction and $100,000 for operation and maintenance.

The Territory of Alaska funds total $3,462,275. This money is earmarked as follows: $2,517,900 for improvement, repair and maintenance of roads, Bridges and trails, and $500,000 for continuation of construction of Richardson Highway.

For construction, operation and maintenance of the Bonneville Power Administration, a total of $9,000,000 was left in the bill. The Bureau of Indian Affairs is listed to receive $4,919,000. This money is to be spent as follows: construction of irrigation systems, $2,343,825; construction of buildings and utilities, $875,300, and construction and maintenance of Indian reservation roads, $1,700,000.

Building board added to HH priorities list

Manufacture of prefabricated houses placed under the National Housing Agency for priority assistance

Building board, except hardboard, has been added to the list of critically short construction materials which may be obtained with housing HH priorities for the building of conventional types of houses, The Civilian Production Administration announced May 7. This material had previously been made available to manufacturers of prefabricated houses on HH ratings, under Direction 8 to Priorities Regulation 33. The addition of building board to the list was made through the issuance of Direction 10 to Priorities Regulation 33, and the amendment of Schedule A of PR-33.

Types of building board to which HH ratings now apply are board made from wood pulp, vegetable fibers, pressed paper stock, or multiple plies of fiber stock, produced for use in building construction and commonly referred to in the building trade as structural insulation board. Included are sheathing, tile board, plank, thin board, roof insulation, laminated fiber wall board and laminated fiber tile board. Hardboard is not included.

Prefabs for veterans under N.H.A.

The Civilian Production Administration on May 7 transferred to the National Housing Agency authority over manufacture of prefabricated houses under the veterans' housing program. The action was taken by amendment of Direction 8 to Priorities Regulation 33.

Third-quarter applications from prefabricators for priorities assistance to obtain certain scarce building materials will be processed by the National Housing Agency. Applications for the third quarter, on Form CPA-4415, may be obtained from NHA and must be filed with that agency by May 24. In the interim, the Civilian Production Administration will continue to act on applications from prefabricators for priorities aid for the second-quarter, ending June 30.

Loose shipment ruling

Loose shipment of construction plywood and gypsum lath in a prefabricator's "package" for use in assembling prefabricated housing is prohibited in the amended Direction 8. The prohibition does not affect the shipment of these materials when they have been physically incorporated in a prefabricated house, section or panel, and is made to prevent any uneconomical use of these critically short materials.

Start Missouri basin 10-year program of water resources development

Corps of Engineers has $39,000,000 to start projects while the Bureau of Reclamation will receive $10,000,000 to begin its work

The signature of President Truman, attached May 3 to the 1947 fiscal year appropriation bill passed by Congress April 19, makes possible a substantial start on a 10-year program for flood control and utilization of water resources of the Missouri River basin under the so-called Pick-Sloan plan. The bill gives the Missouri River Division of the Corps of Engineers $30,000,000 for construction work in the fiscal year beginning July 1, 1946. This is in addition to approximately $9,000,000 appropriated for the Missouri basin work of the Corps of Engineers contained in the deficiency bill passed last December.

The Bureau of Reclamation also is expected to receive somewhere near $10,000,000 to start work this year on its part of the development program, which is the irrigation phase. The Department of Agriculture and the Federal Power Commission also are participating in the general basin program.

Many projects to start

With $39,000,000 available with which to make commitments for construction of reservoirs, levees and channel improvement work, Maj. Gen. Lewis A. Pick, Missouri River Division Engineer, Omaha, has announced the schedule of work to be gotten under way.

General Pick is the author of the Pick Plan submitted to Congress in the summer of 1943. It later was combined with a plan of the Bureau of Reclamation of the Department of Interior, which was submitted to Congress in the spring of 1944. The two plans were incorporated in the 1944 Flood Control Act.

Allocation of funds

Construction funds were provided in the 1947 appropriation for the Engineers as follows:

Garrison Reservoir in North Dakota, $4,000,000; Fort Randall Reservoir in South Dakota, $3,500,000; Harlan County Reservoir on the Republican River in Nebraska, $1,750,000; Kanopolis Reservoir, $1,972,000; Cherry Creek Reservoir near Denver, $2,986,500; for floodwalls and levees at the two Kansas Citys, $2,500,000; Omaha levees, $800,000; Council Bluffs levees, $500,000; Kensler's bend bank protection works just above Sioux City, Iowa, $360,000; for channel improvement work between Sioux City and Kansas City, $2,500,000 for channel improvement work from Kansas City to the mouth of the Missouri, $1,500,000.

Appropriated for planning on other projects were: $1,000,000 for Missouri River levees from Sioux City to the mouth; $50,000 each for Arlington and Richland reservoirs in Missouri; $700,000 for Oahe reservoir in South Dakota; $20,000 for flood control planning at Sioux City.

The construction schedule announced by General Pick on Corps of Engineer projects follows:

Garrison Reservoir—Contracts for an access highway and railroad have been let. Bids have been received on a construction bridge and bids advertised for initial construction of a city to house construction workers.

Harlan County Reservoir—Contracts will be let for an access road, construction camp, and for start of work on the earth dam.

Fort Randall Reservoir—Contracts will be let for an access road and railroad, bridge and townsite.

Cherry Creek Reservoir—Initial contract for construction of the earth dam will be let this year. It will provide flood protection for Denver.

Kanopolis Reservoir—Contract has been let and work started on completion of the earth dam which was about 60 percent completed when halted by the war.

Kansas City—Work is under way on a floodwall to protect the Central Industrial District; a second contract has been let for construction of a levee to protect the Municipal Airport and a section of North Kansas City. It may be possible to let a contract yet this year for a new bridge over the Liberty Bend cutoff project just East of Kansas City.

Omaha—Bids have been advertised for construction of the first unit of an earth levee around the East Omaha District, including the municipal airport, and advanced planning is under way for a second levee unit.

Council Bluffs—Bids have been advertised for construction of the first unit of an earth levee to extend from Big Lake to the Union Pacific Railroad bridge.

Kensler's Bend—One contract has been let and another advertised for construction of a bank erosion project on the Missouri River between Kensler's Bend and the combination bridge at Sioux City, Iowa.

Hamburg, Iowa—Construction will be started this year on a levee system on both sides of the Nishnabotna River from Hamburg to its mouth, using $236,000 appropriated in the deficiency bill.

Cottonwood Springs Creek Reservoir—Contract will be let this year for construction of a reservoir near Hot Springs, S. D., to provide flood protection.

Schuyler, Neb.—Construction will start this year on local flood protection along the Platte River for the benefit of Schuyler.

Approves $400,000,000 housing supply subsidies

Upon reconsideration of the Patman housing bill (H. R. 4761) the House has approved $400,000,000 as subsidies to increase the output of building materials for housing construction. The Senate some time ago voted for $600,000,000, but the House failed to provide money for this purpose. The bill now goes back to the conference committee which failed to settle the subsidy question (*ENR* May 9, vol. p. 752).

Both the Senate and the House have already agreed to the following provisions in the bill: An increase of $1 billion in authority of the Federal Housing Administration to insure home mortgages; continuance after June 30 of priorities for channeling scarce building materials into housing construction; preference for veterans in purchase and rental of new houses; ceiling prices on new houses; and authority for administrator Wyatt of the National Housing Agency to instruct the OPA to change the price of building materials.

Aerial pipe line crossing of Mississippi proposed

Permission to span the Mississippi River with an aerial natural gas pipe line more than two miles in length has been requested by the Tennessee Gas and Transmission Co. of Houston, Tex., it is announced by Lt. Col. R. W. Sauer, Vicksburg district engineer. The crossing would be near Greenville, Miss., and if built would be the first such structure to cross the river.

The plans submitted, according to Colonel Sauer, show an aerial suspension type pipe line crossing 11,676 ft. in length, and capable of accommodating three 26-in. pipe lines.

Resting on five piers in concrete caissons, the crossing will stand 65 ft. above the maximum high water—the same vertical clearance as that of the Greenville bridge. Four spans, three of them 3,336 ft. and one 1,668 ft. in length, are planned, with the low steel elevation 205.0 ft. above sea level. Horizontal clearance of the channel span will be 3,316 ft.

Action to improve safety on highways approved at Washington conference

Work to improve highway facilities calls for 12-point engineering program—More effective law enforcement demanded

A far-reaching plan of action to obtain greater safety on the nation's highways was adopted at the three-day highway safety conference held in Washington, May 8-10, at President Truman's request and attended by more than 1,800 people.

The President, at the opening session, outlined the great need for action to provide greater safety when he said: "The mounting toll of traffic fatalities in this country continues to be a cause for deep concern. More than 8,000 men, women and children were killed on the streets and highways during the first three months of this year. These tragic figures emphasize the need for a concerted attack on traffic accidents."

The President warned the states that they could not expect the federal government to stand idly by while "nuts" and "morons" and "crazy people" were driving cars and contributing in large degree to mounting death and injury tolls on the highways.

The work at the conference was carried out largely by several major committees that had held previous meetings and which made definite recommendations at the conference that were adopted. Recommendations of greatest interest to the construction industry were those of the Committee on Engineering.

Engineering program

The major points of action outlined by this group were as follows: (1) Greater attention to safety and operating factors at the design stage of vehicles and roadways, including modernization of principal streets and highways, with general application of the standards developed by the American Association of State Highway Officials, the Public Roads Administration, and other appropriate agencies.

2. Elimination of railway-highway grade crossings on priorities determined on the basis of hazard and economy of operation.

3. Provision where needed of sidewalks and other pedestrian protection facilities.

4. Maintenance of roadways so that they will be safe for year-round travel.

5. Provision of modern street and highway lighting on main urban streets and on the more hazardous sections of suburban and rural highways.

6. Application of modern planning and traffic engineering techniques.

7. Adoption of the vehicle size and weight limitations recently proposed by the AASHO and consideration of these new provisions in future revisions of the Uniform Vehicle Code.

8. Adoption by all jurisdictions of the provisions governing traffic signs, signals, markings, and islands, contained in the manual on uniform traffic control devices.

9. Establishment of speed restrictions in accordance with Act V of the Uniform Vehicle Code, including wider application of the zoning principle there recommended, especially in the marking of safe speeds on curves.

10. Establishment of an effective and continuing liaison among motor vehicle manufacturers, roadbuilders, and traffic engineers to promote closer coordination of vehicle design, the geometric and structural plans for roadways and plans for operation and traffic control.

11. Employment of a practical means within the appropriate political subdivisions for coordinating the everyday and long-range efforts of engineers engaged on planning, zoning, housing, street and highway development, and other activities related to highway safety.

12. Extended engineering research into human and physical factors relating to safety in traffic operation.

Maj. Gen. Philip B. Fleming, Administrator of the Federal Works Agency, was general chairman of the conference and Commissioner Thos. H. MacDonald of Public Roads Administration was chairman of the coordinating committee. Gibb Gilchrist, President of Texas A. & M., served as chairman of the engineering committee.

Better law enforcement

In addition to the program outlined above, a plan calling for greater emphasis on safety education and traffic-law enforcement was adopted. To obtain better enforcement and thus reduce accidents, the conference went on record in favor of establishment of uniform traffic laws, increased personnel and better trained men for enforcement work, and organization of special courts and employment of specialized personnel to deal with traffic cases.

The committee on education recommended that schools at all levels conduct safety programs giving adequate guidance in accident prevention. Suggestions for making the 30,000,000 children and college students in the U. S. more safety minded included improved courses in safety training, increased facilities for advanced safety study and research, and greater assistance by schools and colleges to agencies engaged in the training of highway transportation personnel.

The program adopted pertaining to motor vehicle registration calls for establishment in all states of motor vehicle departments as independent units of the state government with adequate budgets. Improved driver licensing and greater control of licensing by enactment and enforcement of financial-responsibility laws are also planned.

Regional organizations planned

To mobilize on a nation-wide basis for execution of the adopted safety program, the conference recommended early creation on an equal status of the following three safety committees; a coordinating committee for federal departments, a national committee of state officials, and a national committee of non-official organizations. The program of action calls for each state governor to establish a committee to plan in detail that state's safety program. The governors are also urged to hold a state highway safety conference as a first step in executing this program. County, city and local groups are urged to take similar action.

Washington construction delayed by strike

About $2,000,000 of construction in the District of Columbia is now being seriously delayed by a strike for increased pay of 150 men employed by the Smoot Sand & Gravel Co. This firm is one of the largest producers of sand and gravel in the Washington area.

Two AFL unions are involved. They are Local 77 of the International Brotherhood of Operating Engineers and Local 639 of the International Brotherhood of Teamsters. The men went on strike May 9 and on May 13 were still out.

Wisconsin River power plan

Two errors appeared in a news report on proposed use of pumped storage to firm Wisconsin River power (*ENR*, Apr. 11, 1946, vol. p. 520). Three ciphers were omitted from the figure giving the capacity of the reservoir to be constructed on the Little Eau Pleine River. The capacity actually will be about 18¾ billion cu. ft., instead of the 18,730,000 cu. ft. erroneously reported. Four coaxial flow pumps to raise water from the Wisconsin River into this reservoir will have a total pumping capacity of 5,000 cu. ft. per sec. against a 25-ft. head. In the April 11 report, this capacity was mistakenly ascribed to each of the four pumps.

A survey of the current conditions in the engineering schools

(5th and last of a series of reports from leading technical institutions)

School of Engineering, Stanford University, Calif.—"The university as a whole now has its largest registration. Some 550 new students were admitted in April out of 1,750 who applied. Some schools, such as business administration, have set limits. Engineering has not yet set a limit but may have to do so before next autumn, especially in the lower division. The summer quarter will begin June 20, and the autumn quarter Sept. 23.

"Housing has become a severe problem and demand for dormitories has exceeded our capacity. In spite of efforts of the university, we have been unable to obtain additional accommodations. Admission may be based upon a student's making his own arrangements after arrival. We are unable to assure a student of the type of housing needed prior to his arrival.

"We have made no changes in courses, except that a review course in mathematics (through calculus) is being given, without credit. Some students are repeating or auditing courses, without credit."—Leon B. Reynolds, acting executive head, Civil Engineering Department.

Pratt Institute, Brooklyn, N. Y.—The School of Engineering at Pratt Institute will increase its September freshman enrollment, 50 percent over the maximum prewar figure, by expanding its facilities to accommodate 300 new students. The Brooklyn school, which will also double its teaching staff, has established no priority for veteran applications other than those from former students.

Eighty percent of the applications at Pratt Institute for next fall are from former service men.

College of Engineering, University of Wisconsin, Madison, Wis.—"Enrollment in undergraduate courses is limited to state students. That restriction does not apply to graduate students; however, the scholastic requirements for entrance to the graduate school have been raised somewhat.

"Our enrollment of undergraduate engineering students is higher than ever before. Most of the students are in the freshman and sophomore years, so that our facilities in drawing and surveying are taxed to capacity. Junior and senior classes are not loaded to capacity.

"Housing continues to be a problem, especially for married students. The university has established a large trailer camp on the campus. It has also converted some of the buildings at Truax Field (on the edge of the city) into housing units for GI students. Some students and faculty members are living at the Badger Ordnance Plant, thirty miles away, and are commuting by a university operated bus line.

"The college is not offering any refresher courses.

"There will be an 8-weeks summer term this summer. In September, the college will go back to its regular schedule. Registration for the fall semester will begin on Sept. 19."—L. F. Van Hagan, chairman, Department of Civil Engineering.

Lehigh University, Bethlehem, Pa.—"Accepting students to matriculate in June and October, 1946. Dormitories, fraternity chapter houses and off-campus rooms accommodate single men adequately, and other accommodations to provide for married students now entering. By June we expect the 100 temporary units assigned to us will be ready.

"Refresher courses for veterans, and a certain number of new courses."—B. C. Hayes, assistant director.

The Citadel, Charleston, S. C.—"We have accommodations for more veterans than have applied. We can take more students in both the upper and the lower classes. New students will be accepted July 8 and September 30.

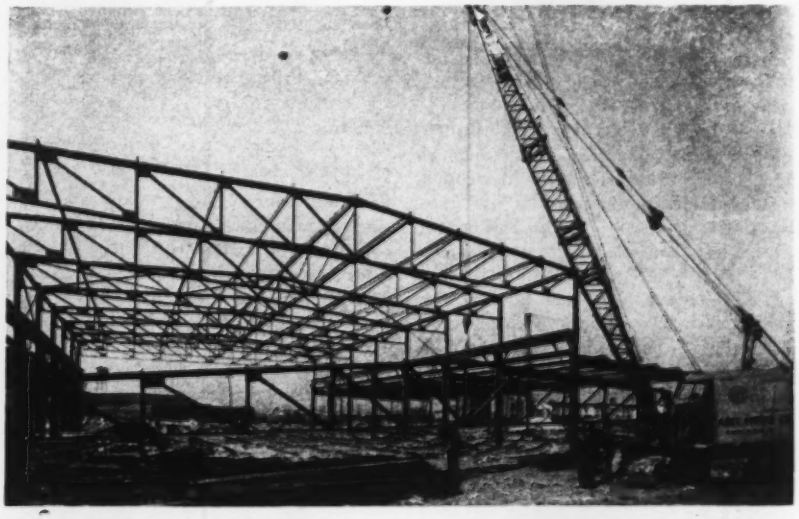
"The housing situation for married students is not by any means satisfactory. However, in and near Charleston there are a number of housing projects erected during the war and we hope to be able to make arrangements to obtain priorities in these developments.

"We have made no changes in our regular courses of study and are not in a position to give refresher courses for returning veterans."—L. A. Prouty, registrar.

Army engineers plan river recreation areas

Plans for large recreational areas around the pools above Mississippi River dams 24, 25 and 26 between Alton and Saverton, Mo., and on the Illinois River to the LaGrange Dam have been drawn up by the St. Louis district office of the U. S. Engineer Department.

The proposed program, under the supervision of Lt. Col. E. R. Swanson, will include development of facilities for camping, fishing, hunting, boating and swimming. Various civic, religious, industrial, sporting and youth organizations in the St. Louis area will co-operate with the engineers' office in developing the program. The sites on government-owned property would afford outdoor recreation for 2,270,000 persons, Colonel Swanson said.



***Set Trusses for Illinois Factory**—At Cicero, Ill., Abel-Howe Co., engineer-contractor of Chicago, set 2½-ton, 76-ft., 10-in. roof trusses for center bay of industrial building. CPA's recent limitation order (ENR March 28, vol. p. 441) will not stop a large volume of similar industrial building, although contractors will have to get along without priorities which now go to homebuilders.*

Materials shortages hinder housing

(*Continued from page 54*)

It is difficult to understand why industrial plants will discharge their liquid wastes into waterways without compunction but would not think of piling their solid wastes on highways.

It is high time, concluded Mr. Wolman that industry substitute technological conscience for legal advice in matters pertaining to the disposal of wastes. In this connection he urged that industry adopt a vigorous program of research in waste treatment, and that the cost of both research and construction of treatment works be considered as a legitimate cost of production in the manufacture of products.

Better water for the Army

In a frank appraisal of Army water supply organization during World War II, William A. Hardenbergh, editor of *Public Works*, N. Y. and formerly a colonel in charge of the Sanitary Corps, declared that in the field it was, at the best, only adequate and could not be termed satisfactory. In certain areas, where only supply troops were stationed the situation was totally inadequate.

Divided responsibility, lack of planning and inadequate organization resulted in many difficulties and problems in the field, said Mr. Hardenbergh. That most of these were overcome and that the army generally had safe water is a tribute to the sound technical training and good sense of the young men of the Sanitary Corps and the Corps of Engineers. There were few cases where water could be shown to be the medium of spread of disease.

This happy ending, concluded the former colonel, does not lessen the desirability of better planning and preparation for the future. Army water supply needs to be brought up-to-date and reorganized with the lessons of World War II as a basis. The problems that arose were the result of lack of foresight, inadequate advance planning and the inflexibility of army procedures coupled with the necessarily large degree of decentralization of authority to overseas commanders.

Awards and officers

Honorary membership was conferred on John R. Baylis, engineer of water purification, Chicago, and Edgar G. Ritchie, retired chief engineer of waterworks, Melbourne, Australia. Other awards included: the John M. Diven medal to James C. Harding, consulting engineer, Mt. Kisco, N. Y.; and the John M. Goodell prize (provided by *Engineering News-Record* in memory of a former editor) to C. M. Riedel, consulting engineer, Chicago. The George W. Fuller awards were presented to 44 members of the association.

Wendell R. LaDue, general manager of the Akron, Ohio Water Department, who had previously been elected president in a letter ballot, officially was installed in office by the retiring president, Leonard N. Thompson, general manager of the St. Paul Water Department. (See *ENR* May for a biographical sketch on Mr. LaDue.)

N. T. Veatch, of Black and Veatch, Kansas City consultants, became vice president and Willian W. Brush, editor of *Waterworks Engineering*, New York, continues as treasurer of the association.

Manufacturers elect Paxton

The Water and Sewage Works Manufacturers Association elected A. E. Paxton, publisher of *Engineering News-Record* as president, and Daniel J. Saunders, manager of industrial sales, Permutit Co., as vice-president. Edgar Buttenheim, president of the American City Magazine Corp., is treasurer and Arthur Clark was reappointed as full-time secretary for the organization.

The manufacturers association voted unanimously to participate in and provide $10,000 financial aid to the Pan-American sanitary conferences to be held in Rio de Janeiro, Brazil, in June, and Caracas, Venezuela, in September (*ENR* May 2, vol. p. 689). Details concerning the meetings were provided by Clarence Sterling, chief engineer of the health and sanitation division, Institute of Inter-American Affairs, one of the sponsoring agencies. Mr. Sterling, who had just returned from South America, reported that Sweden and Russia were aggressively pushing commercial relations and that there was some talk of Russia providing free engineering services with the sale of equipment.

This 66th convention was the fifth held by the AWWA in St. Louis. In fact, the organization looks upon St. Louis as its "birthplace", the first meeting having been held here at Washington University in 1881; other conventions were held in this city in 1904, 1918 and 1930.

In contrast to the 20 active members and four manufacturers who met for the first time in 1881 there were 1,517 registrants and 89 manufacturers present last week. The previous high record was 1,467 attendance at Kansas City in 1940.

Among those attending the convention was Michael Nikolaevich Shestakov, chief engineer of water supply and sewage disposal in Moscow, Russia. He stated that he was making a tour of this country to study latest improvements in water service before he begins reconstruction of the Moscow system. Beyond this he declined to make any further statements.

(Abstracts of principal papers at the technical sessions will be published in a forthcoming issue)

JOBS OF THE WEEK

REMODELING BUILDING, Flushing, N.Y.C.

James King & Son, Inc., New York, N. Y., has been awarded a contract for converting the New York City Building, at Flushing Meadow Park to headquarters for U. N. General Assembly by Department of Parks, New York, N. Y., at $1,410,060.

OFFICE, Portland, Ore.

Ralph & Horwitz, Portland, Ore., will construct a 14-story office for T & H Corp., Portland, at about $3,500,000. Dougan, Heims & Caine, Portland are the architects.

RESIDENCES, Hayward, Calif.

David D. Bohannon, San Mateo, will construct a prefabricated subdivision by his own forces, to cost $8,000,000.

PULP MILL, Port Alberni, B. C.

British Columbia Bridge & Dredging Co., Ltd., Vancouver, B. C., has been awarded a contract for a pulp mill and equipment by Bloedel Stewart & Welch, Ltd., Vancouver, at $7,000,000.

FORT GIBSON DAM, Oklahoma

U. S. Engineers, Tulsa, awarded a contract for the construction of Fort Gibson Dam to Al Johnson, Construction, Winston Brothers Co. and Peter Kiewit Sons Co., Minneapolis, Minn., at $12,203,692.

RESIDENCES, South San Francisco, Calif.

Buri-Buri Co., So. San Francisco, (Barrett & Hilp, San Francisco), will construct residences, shopping center, school and hotel, by its own forces at about $10,850,000. Frederick L. Confer, Oakland, is the architect.

Note—Additional bidding and contract news on many projects large and small, including the above items, appear in the Construction News section beginning on page 159.

NEWS IN BRIEF

In telegraphic form, here are latest news developments on the engineering and construction front during the week.

Bond Issues—*Spokane, Wash.*, will vote June 4 on a $1,700,000 bond issue to finance part of a $4,000,000 sewage disposal system. . . . In *Pensacola, Fla.*, county school officials propose a $2,000,000 bond issue for four new school buildings and additions to five others. . . . Extensive street, sewer and airport improvements are proposed for *Columbus, Ga.*, to be financed by $1,650,000 county bonds and $1,740,000 city bonds. . . . *Santa Ana, Calif.*, is seeking to float an issue of $1,500,000 street and sewer bonds. . . . *Arcadia, Calif.*, citizens have voted $350,000 for sewer lines connecting the city to the county sanitation system. . . . In a second balloting, *Tallahassee, Fla.*, freeholders approved a $750,000 school building bond issue.

Construction—Industrial projects for which Civilian Production Administration approval has been granted recently include: a $6,300,000 paper mill for Riegal Paper Co. at *Acme, N. C.*; Armstrong Cork Company's new $4,000,000 factory at *Macon, Ga.*; a $2,650,000 addition to the *Bartow, Fla.*, plant of International Minerals & Chemicals Corp.; a $2,500,000 factory for Victor Chemical Co. at *Tarpon Springs, Fla.*; a wallboard plant at *Shelton, Wash.*, for Simpson Lumber Co., to cost $941,000; and Northwest Airlines new $650,000 hangar at the *Seattle-Tacoma* airport. . . . Inland Steel Co. plans to build a $12,000,000 addition to its *East Chicago, Ind.*, plant. . . . American Foods, Inc. has picked a site at *Lafayette, La.* for a $1,000,000 plant. . . . Department of Agriculture has awarded the contract for its new $3,500,000 14-story office building in *Portland, Ore.* to T & H Corp. . . . New York State Post-War Public Works Planning Commission has provided funds for the planning of a $400,000 school at *Syracuse, N. Y.* . . . A campaign is under way to raise $1,500,000 for an 8-story addition to St. Joseph's Infirmary at *Atlanta, Ga.* . . . In *Halifax, N. S.*, will be erected a new $1,000,000 Victoria General Hospital. The province has also appropriated $540,000 as its share in building vocational schools in *Halifax* and on *Cape Breton Island*, and $320,000 for a new dormitory at Nova Scotia Agricultural College, *Truro*. . . . Site of a new commercial center in *Minneapolis, Minn.*, to cost $1,250,000, has received re-zoning approval from the city planning commission. . . . A total of 1,600 residences and 400 apartment units would be provided in the Shades Valley section of *Birmingham, Ala.*, by a $30,000,000 subdivision planned by the Moretani Brook Development Co. . . . All new building in Canada after June 1 will be placed under the control of War Time Housing, Ltd., *Toronto, Ont.* . . . In the Tualatin Valley, 5 miles from the center of *Portland, Ore.*, Commonwealth, Inc., and Equitable Savings & Loan Assn., have laid out a 2200-home, $25,000,000 development.

Highways—*Oklahoma's* State highway commission has submitted to the Public Roads Administration a revised 1946 program, calling for the expenditure of $15,356,140 this year. Most of the projects have already been approved by the PRA. The commission recently let contracts totaling in excess of $1,000,000 for 32 projects in 22 counties, most of them farm-to-market connecting roads. *Minnesota's* highway department has awarded contracts totaling $639,824 for four paving and grading projects and opened bids totaling $1,752,305 on 11 trunk highway grading jobs. . . . *Illinois* has been allocated $14,285,000 of federal and $7,142,000 state funds to be spent over the next three years on federal-aid secondary highways in 102 counties. . . . The expenditure of $2,185,743 by *Wisconsin* for improving 67.1 miles of highway in 8 counties has been approved by the governor. . . . Largest contract letting in *Montana's* history is scheduled for May 21 when bids for projects estimated to cost $2,520,700 will be opened. The state highway commission awarded contracts totaling nearly $1,600,000 in April. . . . *San Diego, Calif.*, has awarded a contract for $1,098,940 for construction of a 4-mile stretch of Cabrillo freeway. . . . *Nova Scotia* has appropriated $8,000,000 for expenditures on highways and public works, of which about $5,000,000 will be spent on roads.

Calendar of Meetings

NATIONAL

International City Managers' Association, annual meeting, Montreal, Canada, June 16-21.

Society for the Promotion of Engineering Education, annual convention, Jefferson Hotel, St. Louis, Mo., June 22.

American Society for Testing Materials, 49th annual meeting, Hotel Statler, Buffalo, N. Y., June 24-28.

Society for Experimental Stress Analysis, spring meeting, Hotel Statler, Buffalo, N. Y., June 24-26.

Associated General Contractors of America, Washington, D. C., Spring governing and advisory board meeting, Shirley-Savoy hotel, Denver, Colo., June 29-July 2.

REGIONAL

New England Sewage Works Association, Pickwick Arms Hotel, Greenwich, Conn., May 17.

Pacific Northwest Sewage Works Association, Gearhart Hotel, Gearhart, Ore., May 22.

Pacific Northwest Section, American Water Works Association, Gearhart Hotel, Gearhart, Ore., May 23-24.

New York State Sewage Works Association, spring meeting, Hotel Hamilton, Utica, N. Y., May 24-25.

North Carolina Society of Engineers, annual summer convention, Wrightsville Beach, N. C., June 7-8.

Third Hydraulics Conference, State University of Iowa, Iowa City, Iowa, June 10-12.

California Sewage Works Association, 1946 convention, Monterey, Calif., June 9-11.

North Carolina Waterworks Operators' Association, annual operators' training school, Chapel Hill, N. C., June 10-15.

Ohio Conference on Sewage Treatment, Mayflower Hotel, Akron, Ohio, June 20-21.

New Jersey Section, American Water Works Association, summer meeting, Little Falls, N. J., June 28.

Final report submitted on Philadelphia water

Rehabilitation of Philadelphia's water system will cost $62,568,000 at the very least, but $284,586,000 additional will be needed if the proposed upland water supply is developed. This was disclosed last week in the final report of the board of consulting engineers studying the city's water needs.

Supplementing a preliminary report submitted last fall (*ENR* Dec. 13, 1945, vol. p. 770 and Jan. 24, 1946, vol. p. 138), the final report deals with detailed costs for construction and operation of a new upland source of supply. It also contains a critical appraisal of the existing waterworks system and sources of raw water supply, and outlines the facilities needed for their continued and effective use.

The new upland supply selected for development in the final report was designated in the preliminary report as the "Delaware River Project." It includes construction of an impounding dam across the Delaware at Wallpack Bend; a regulating reservoir near Warrington, Pa.; and 81 mi. of pressure tunnels connecting with the existing Queen Lane filter plant, where new rapid sand filters would be constructed.

The report recommends additional filtration facilities at the Torresdale and Belmont stations, as well as distribution system replacements. These improvements are deemed necessary even if the city should go to an upland source. The Board of Consultants consists of: C. A. Emerson, N. B. Jacobs, G. T. Requardt, F. S. Friel and J. D. Justin.

OBITUARY

C. B. McCullough, 58, assistant chief engineer of the Oregon State Highway Department, died at Salem, Ore., May 6. Born in Redfield, S. D., he was graduated from Iowa State College and for 6 years was engaged in highway work in that state before becoming assistant professor and later professor of civil engineering at Oregon State College. In 1919 he was made bridge engineer of the Oregon State Highway Department and became assistant chief engineer in 1932, which position he occupied until his death. From 1932 to 1935 he was loaned to the U. S. Bureau of Public Roads as senior bridge engineer at San Jose, Costa Rica, where he supervised a number of important river crossings in the Central American portion of the Inter-American highway. He designed many important bridges in the Oregon highway system, including the notable structures on the Coast Highway. He was active on the Bridge Committee of the American Association of State Highway officials, and was the author of several books, including *Economics of Highway Engineering, Elastic Arch Bridges* and *The Engineer at Law,* the last of which reflected his long-time interest in the study of law which led him to pass the Oregon bar examination.

Walter C. Bish, 44, an erecting engineer with Allis-Chalmers Mfg. Co., Milwaukee, Wis., for 23 years, died in that city April 28.

Hayden T. French, 59, former Ohio State Highway assistant engineer, died in Akron, Ohio, April 28. He had been superintendent of the B. F. Terry Construction Co. there since last July when he left the state highway department.

Frederick C. Tuttle, 69, industrial engineer, died in Oakland, Calif., April 26. He had been identified with construction of the Southern Pacific bridge at Benicia, the Oakland-San Francisco Bay bridge, and Carquinez bridge near Vallejo.

Guy J. Johnson, airport engineer at Seattle, Wash., for the Civil Aeronautics Administration, died recently in that city. A native of Wisconsin, he moved to Seattle as a young man and was graduated from the University of Washington in 1914.

William F. Dennis, 85, railroad builder and formerly a member of the firm Rinehart & Dennis, Richmond and Charlottesville, Va., died at Washington, D. C. May 2.

Airport bill signed

(*Continued from page* 53)

Administrative buildings may be included in allowable project costs, but hangars may not. None of the federal funds may be allocated for construction projects undertaken prior to the enactment of the law, but a proportion of engineering and planning costs previously made may be included. Government agencies such as the CAA and the Weather Bureau shall be provided office space rent free but these agencies shall be required to pay for such services as lights, water and janitorial help on a pro rata basis.

An amendment permitting a sponsor in one state to receive funds for building an airport in a contiguous state was retained. Sponsors from two or three states, where their boundaries meet, may unite on a project and receive federal funds if the project is approved.

No financial assistance to local construction groups can be supplied until an appropriation bill has been passed. However, these groups will be urged by the CAA to get their plans prepared and approved by it. To expedite this work, the CAA is setting up an office in almost every state, but this work will take considerable time.

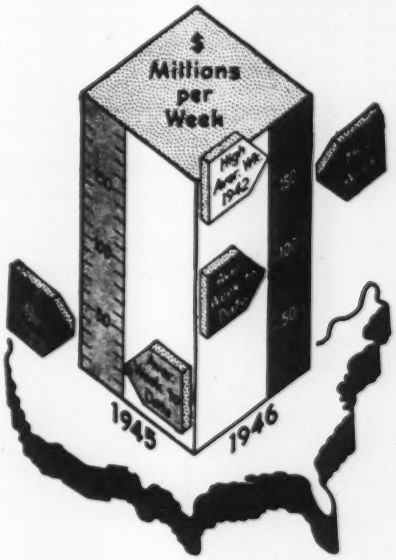
In the meantime, sponsors are requested to contact one of the nine regional offices of the CAA. The addresses of these offices are as follows: 385 Madison Ave., New York City; 84 Marietta St., N.W., Atlanta, Ga.; 608 South Dearborn St., Chicago 5, Ill.; P.O. Box 1689, Fort Worth 1, Tex.; City Hall Building, Kansas City 6, Mo.; 1500 Fourth St., Santa Monica, Calif.; P.O. Box 3224, Seattle 14, Wash.; Anchorage, Alaska, and Honolulu, Hawaii.

CAA officials estimate that actual work cannot be commenced on any significant number of projects before the next construction season, that is, April, 1947. It will take that much time to carry out the preliminaries. Sending delegations to Washington to press for action on specific projects will serve only to slow down progress, the CAA states, as the program will be administered largely through the regional offices of the CAA.

Ohio drainage study

The Northwestern Ohio Drainage Association, representing 23 counties, will conduct a year's study of the state's drainage laws and submit new proposals to the 1947 session of the state legislature. Studies will be concentrated on organization of small drainage districts, maintenance of ditches, and methods of assessing for ditch maintenance.

CONSTRUCTION ACTIVITY



As Reported this week to . . .
Engineering News-Record

CONTRACT VOLUME

Continental U. S. Only
(Thousands of Dollars)

	Week of May 16 1946	Cumulative 1946 (20 wks.)	Cumulative 1945 (20 wks.)
Federal	$22,971	$236,446	$364,222
State & Mun.	35,173	435,348	86,488
Total Public	$58,144	$671,794	$450,710
Total Private	79,678	1,228,905	178,411
U. S. Total	$137,822	$1,900,699	$629,121

WHERE CONSTRUCTION ACTIVITY ORIGINATED THIS WEEK

Type of Work	Dollar Volume (Thousands) This Week	Cumulative 1946 (20 wks.)	Cumulative 1945 (20 wks.)
Waterworks	$1,663	$39,354	$15,342
Sewerage	1,024	24,180	11,700
Bridges	2,349	44,774	10,494
Highways	23,011	246,892	59,814
Earthwork, waterways	18,243	145,167	13,709
Buildings, Public	5,865	109,634	256,396
Industrial	14,311	379,708	125,634
Commercial	63,708	772,920	31,092
Unclassified	7,638	138,070	104,940

NOTE: Minimum size projects included are: waterworks and waterway projects, $22,500; other public works, $40,000; industrial buildings, $55,000; other buildings, $205,000.

NEW PRODUCTIVE CAPITAL

	Cumulative 1946 (20 wks.)	Cumulative 1945 (20 wks.)
NON-FEDERAL	$367,154	$241,678
Corporate Securities	150,922	69,993
State and Municipal	216,232	150,785
RFC Loans	.....	20,900
FEDERAL	158,320	251,010
Total Capital	$525,474	$492,688

ENR INDEX NUMBERS

Index Base = 100		1913	1926
Construction Cost	May '46	339.69	163.29
Building Cost	May '46	257.25	139.06
Volume		340	149

EDITORIALS

VOLUME 136 NUMBER 20

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Better Pile Foundations

LACK OF KNOWLEDGE of subsurface conditions undoubtedly causes more delays, more headaches and more expense to pile-supported structures than do defective materials, poor workmanship or willful skimping combined. It is significant that little difficulty is experienced with heavy loads even on soils of low bearing value when the characteristics of the soil are known. The real difficulties arise when guesswork or ignorance are substituted for knowledge which can only be supplied by full-depth investigation of subsurface conditions before design and construction start. Guesswork and ignorance are particularly rife in the field of pile foundations, where the science of soil mechanics has caused numerous new concepts to be introduced, and both a greater knowledge of subsurface conditions and of their proper evaluation in terms of pile driving techniques are requirements of this new state of affairs. A series of articles, beginning in this issue, points the way to removal of much of the guesswork in pile driving and to more economical as well as to safer practices. Authoritative and practical, the articles will repay careful reading and reflection.

New Code Aims High

IN ISSUING SO PROMPTLY the section on prefabricated structures of their forthcoming national building code (*ENR* April 25, vol. p. 678), the Building Officials Conference of America has furnished valuable guidance for those cities whose present codes do not permit prefabrication. A highly significant feature of this section is that the tentative draft, dated April 14, 1946, is a performance-standards code, as contrasted with the usual specification type that lists permissible materials and methods and is thus subject to early obsolescent. The high flexibility provided by this draft may be observed in typical clauses: "It is the intent to permit the use of all materials or methods of construction which meet the strength, durability and fire-resistive requirements herein specified . . . ." and "Roof coverings shall be of approved types meeting the requirements of the basic code, consisting of brick, concrete, tile, slate, metal . . . . or similar incombustible moisture-resistant materials . . . . " Thus, materials and methods that satisfy minimum essential standards of health, safety, comfort and durability, some of which have been excluded by many contemporary codes, are permitted. There is reason to believe that wide use of such performance standard codes would remove the throttling effect that many existing codes have on building design improvements. It is to be hoped that the Building Officials Conference of America will bring out the other chapters of its code just as rapidly as possible.

Politics vs. Competence

REMOVAL of Herman A. MacDonald from his position as head of the Massachusetts Department of Public Works for what were said to be chiefly political reasons serves to emphasize again how far we have to go in this country before high administrative positions can be made as attractive as they should be to the right kind of men. Putting such positions under civil service has been suggested, but that involves disadvantages; governors and mayors should be free to select men for high administrative positions without the restrictions that are inherent in civil service laws. Administrators of unusual ability can be obtained provided continued competence, not political affiliation, controls their retention in office. That such a system can work has been demonstrated in the federal service. Such men as Thomas H. MacDonald, head of the Public Roads Administration, and the late Elwood Mead, head of the Bureau of Reclamation, continued through changing administrations because fitness for the job was given greater weight than political connections. A broader application of this principle is greatly in the public interest.

Sharing Sanitation Know-How

THROUGH THE WAR YEARS the United States, through the Institute of Inter-American Affairs, made important contributions to improvement of sanitation in South and Central American countries. Not the least of these contributions was the development of a sympathetic understanding among sanitary engineers of the United States and participating countries toward the solution of hemispheric sanitation problems.

Now that the institute is tapering off its activities, plans are being laid for the formation of a voluntary and permanent Pan-American sanitary organization to which end a meeting will be held in Rio de

Janeiro next month (*ENR* May 2, vol. p. 689). At the American Water Works Association convention last week in St. Louis the manufacturers affiliated with that body voted unanimously to participate in these Pan-American meetings—to send representatives and exhibits, and to defray the expense of publication of the proceedings.

This joint action on the part of the manufacturers of sanitation equipment will do two things: (1) assist in the promotion of United States standards and practice in countries where we profess to be "good neighbors"; and (2) lay the groundwork for a future export market. While the latter objective may seem to be of concern only to the manufacturer, in reality it concerns every one of us if we believe that the things we make are a means to a better way of living. The millions who have been overseas will attest that, at least in the matter of sanitation practice and equipment, we have no equal. We have good reason and responsibility to share this with the world in general and with South and Central American countries in particular.

Physical Hazards on Highways

THE CAMPAIGN to reduce highway accidents that was inaugurated last week at the President's highway safety conference in Washington should receive nation-wide support. Only with such support can there be any material reduction in the deaths and injuries that now total to appalling figures.

In large measure, of course, the success of such a campaign depends on the individual operators of motor vehicles. Nevertheless, there is much that can be done at the time highways and streets are laid out to reduce operating hazards, and there is much that can be done in the maintenance of these roads and streets to reduce travel risks. It is these aspects that are of chief interest to engineers.

Conditions fostering safe or unsafe driving find their origin in details of the highway as an engineering structure, hence the importance of a knowledge of what is conducive to safety when a highway is being designed. This means that design engineers should be intimately familiar with operating problems and traffic hazards. Unless they are conscious of conditions that may cause accidents, their designs will probably be faulty.

Another source of future trouble is too great concern over the initial cost of a project when it is still in the design stage. For example, safety requires long sight distances and easy curves, but these often add to the cost, and so there is a tendency to compromise to make savings that appear large at the time. But in the long view, such savings may be minor compared to the cost in lives and property damage or to operating costs that run on indefinitely from year to year.

This fact should receive special consideration in designs now on the boards for new sections of the National System of Interstate Highways, especially the costly sections serving the major centers of population. Compromises with safe design standards to reduce the amount of high-priced land to be bought should not be approved. Even within cities, grade-separation structures, whose first cost may seem unusually high, may well be justified if they reduce hazards and speed up the free flow of traffic.

Prevention of encroachments on highways is another safety precaution toward which the engineers can make a major contribution. Here again, the right place to start is when land is being purchased for a new highway, but much can be done on existing highways by purchase or condemnation if conditions that contribute to traffic accidents can thus be eradicated.

And there is much that the maintenance men can do alone or in cooperation with the traffic police. Inadequate signs at intersections, which result in sudden stops or hasty turns on the part of strangers, are a major source of accidents. Lack of proper lighting at night is another. Still others are sudden changes in the type or width of pavement, failure to indicate sharp curves or dangerous intersections, and the placing of stop signs according to a rule of thumb rather than the rule of reason. Of all of these, the one offering the most for the least expenditure is better signing. Increasing the size of the lettering and reducing the amount of verbiage used are two generally needed improvements.

There is no easy route to highway safety because initial responsibility rests with the man behind the steering wheel. Nevertheless, engineers can do much to eliminate the opportunities for him to be confused, to make a dangerous mistake, or to force others suddenly into danger. Elimination of these physical hazards calls for best thinking highway engineers have to offer.

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Piles and Pile Foundations

Part I—Avoiding Detrimental Settlement

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***Contents in Brief**—In this first of three articles on the practical aspects of pile foundations the author discusses how piles act in cohesive and cohesionless soils. He also reviews the factors that must be taken into consideration in designing foundations to avoid costly future settlement and in interpreting pile driving records as a guide for determining to what underlying strata the piles should be driven in order to support their design loads. Also included are hints on how not to be duped by a smart pile-driver foreman*

DETRIMENTAL settlement of pile foundations can be avoided by taking adequate precautions in the design of the foundation and driving of the piles, or by refusal to build on a site if thorough investigation, by adequate borings and soil mechanics studies, reveals that settlement of detrimental character cannot be avoided by economical means. Building a structure that is bound to be expensively damaged is a disservice, but dozens of records are available of structures where expenditures ranging even up to amounts equalling the original cost of the entire structure have been required to maintain them in safe condition.

This article is concerned with the precautions that should be taken to avoid settlements, after it has been found economically feasible to construct on any particular site.

Soils are of two general classes, *cohesive* and *non-cohesive*. It generally is cohesive soils that permit damaging settlements although organic silts and peats, which are non-cohesive, are sources of trouble. But, if adequate borings are taken and interpreted by a competent engineer familiar with the principles of soil mechanics and modern pile driving theory detrimental settlements can be avoided.

Yet it is amazing to find that even today properties are purchased and expensive structures are built without exploration of the underlying soil, decisions as to adequacy of the soil to carry the proposed structure being based on hearsay regarding the site, upon results of previous inadequate or unreliable borings, upon performance of similar or nearby structures, or upon the theory that "if in doubt drive piles" (almost any length or types being all that is necessary). Frequently these haphazard methods do not work. Then someone is called upon to pay a large bill and the reputations of engineers suffer.

It should not be thought that adequate investigations are an unnecessary expense. From full knowledge of the underground it will be found more often than not that piles are unnecessary, and, in cases where piles are required, full information may permit use of shorter or otherwise less expensive piles.

Variation in conditions may occur, in short distances. The author recollects a recent instance where it was later found that peat 70 ft. deep occurred just in front of a purchased site and was 100 ft. deep behind it. In another recent instance borings revealed 40 ft. of silt although a building across the street rested upon a deep bed of sand. In some regions it is known that extensive beds of clays or sands prevail, but in general the picture of the underground is one of very irregular and confused topography.

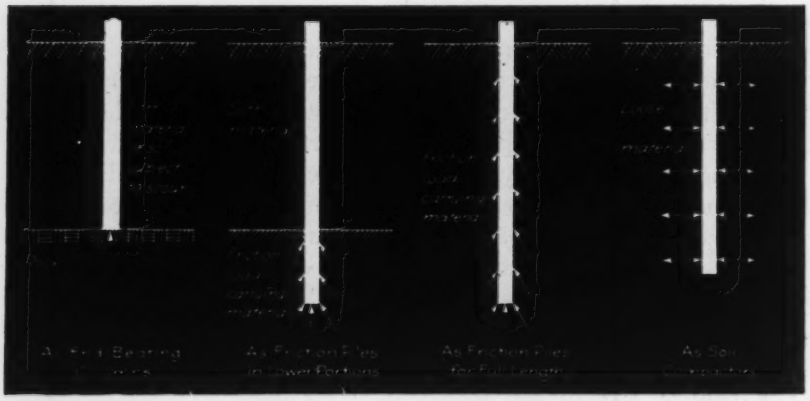


Fig. 1. Four ways in which piles may act for support of structures over different subsurface materials.

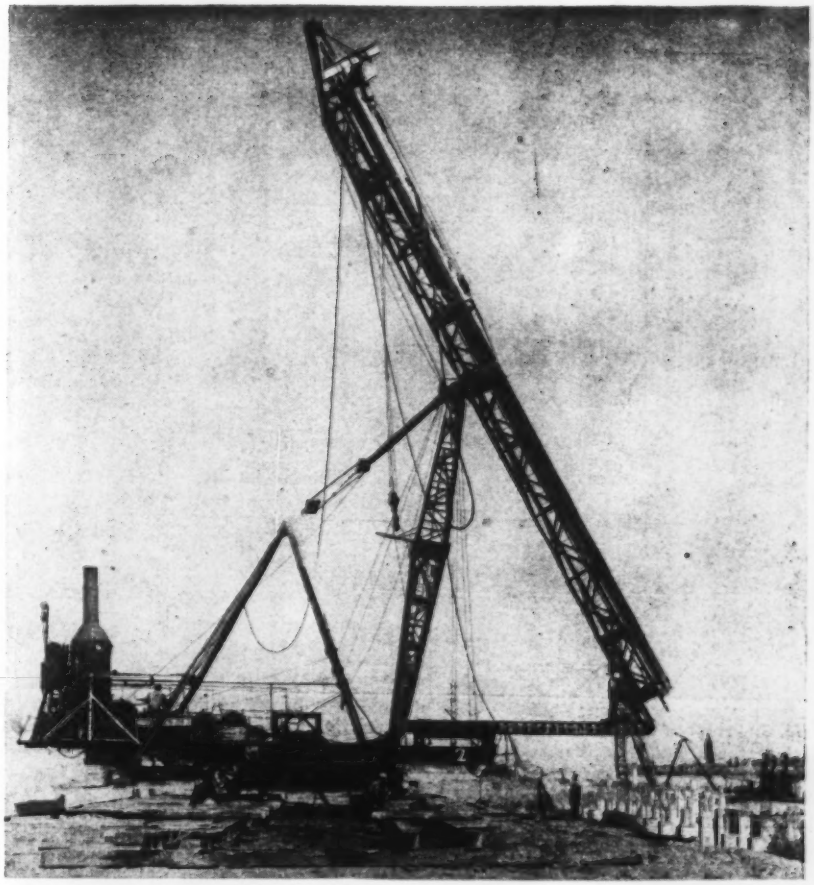
How piles act

To prevent settlement of piles, it is necessary to understand clearly the ways in which they may act—(1) serving as columns to transmit the load from the pile cap through a soft stratum down to rock or hardpan; (2) serving as columns in the upper portion and friction piles in adequate supporting material in the lower portion; (3) carrying the load in friction throughout the entire pile length; or (4) as a means for compacting the soil.

It is clear that if a pile passes through

soft strata and goes to rock, there is no chance of settlement. On the other hand, if the pile tips are stopped in the soft material, large settlements may occur rapidly, perhaps even during construction. In cases where the pile tips are driven into soft clay, the deeper the piles are driven, the larger the probable settlements may be, since the driving serves to remold the clay and lessen such load-carrying capacity as it might have had in undisturbed state.

Where the function of the pile is to transmit the load through upper soft strata into a sand or other good bearing material that overlies a compressible material of such character and thickness that its consolidation under load can be expected, care should be taken not to drive the pile entirely through the firm stratum. This permits retaining the benefits of any end-bearing of the piles in the firm material and avoiding remolding of the softer clay below. It usually is sufficient to stop the tips about 5 ft. above the soft material.



This photo and the cover picture courtesy of Raymond Concrete Pile Co.

Fig. 2. Universal type driver moves on rollers, has full circle swing and leads can be adjusted to any angle or elevation to drive piles on any desirable batter. Cover photo shows similar rig used for driving vertical piles.

Friction support

If rock or firm material is not within reach, there is no chance for the piles to act as columns and they become friction piles. The load resisted by the various strata depends upon the shearing value of the material, commonly considered as friction on the pile. The total amount of friction acting at a given time may be judged from the driving resistance or by a load test. However, there are ways in which settlement can still occur in spite of test results that apparently meet building code and specification requirements. This point is so important that it will be discussed separately later.

If friction piles penetrate a sufficient distance into underlying firm materials, settlements can be minimized or nearly prevented and equalized. All too often, however, short embedments are used because the driving resistance is thought to be enough and the initial cost of the foundation can thus be reduced.

Many persons who claim to be "practical" men, are apt to wish to stop driving the minute fairly good driving resistance is reached, disregarding all other considerations such as resistance from strata not suitable for permanent load-carrying duty, drag that may be imposed by settling upper strata, use of undersized hammers on heavy piles, reductions from group action, and the like.

One of the most common ways of showing a high load capacity for a friction pile is to use the *Engineering News* formula (which does not take into account the weight of the pile) with a heavy pile such as precast concrete or a steel shell driven with a mandrel, or even a very long wood pile. This can readily be seen by noting that the "set" or penetration of the pile less the rebound becomes very small with such piles due to large amounts of energy absorbed by inertia of the pile instead of being available for driving against the soil. This puts a tiny figure in the denominator and results in a gratifyingly large answer.

If a very light hammer is used, then the pile probably will absorb almost all the energy and the sets approach zero very soon. If a formula of the *Hiley* type is used when driving in cohesionless soils the driving resistance seems to agree in general with the load-carrying value of the soil and this type of formula is recommended.

Group action of piles

Reductions of individual pile values when acting in groups often are ignored. This subject and information concerning it is still in a formative stage. Such theories as have been advanced give results that differ considerably, especially in large groups of piles, and are not understood by many engineers. However, it seems true that piles in groups, especially in or over cohesive soils, carry less than the sum of individual separated pile capacities so that the question is only one of degree (Fig. 3).

There are two basic rules that govern the use of friction piles in the upper part of a very deep deposit of fairly uniform consistency. For very

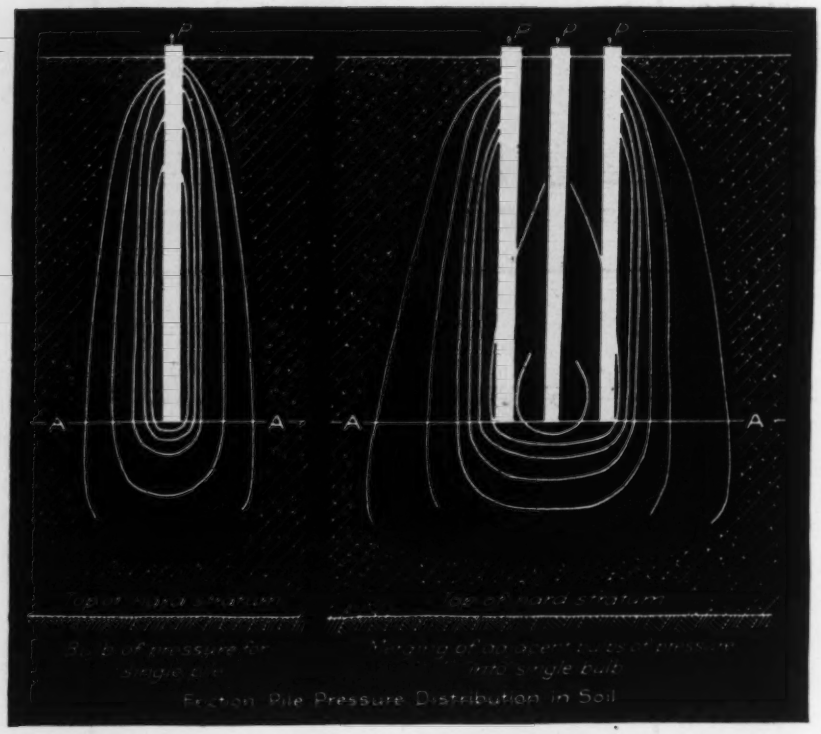


Fig. 3. Pressure distribution in the soil from friction loading on one pile (left) and (right) on a group of piles.

cohesive soils the settlement produced by a unit load increases in proportion to the diameter of the loaded area, while for cohesionless soils the size of the area has little effect. With increasing depth of foundation, the settlement under a unit load decreases.

However, settlement depends not only upon the depth of foundation but upon the ratio of depth to diameter of the loaded area. For equal potential settlement reductions, the depth-to-diameter ratios should be kept equal. For cohesionless materials the effect of this ratio on settlement is less than with greater cohesion.

Consideration of this principle indicates that the value of the piles may be greatly affected by the relation of their lengths to the width of the loaded area. Under a narrow structure every effort should be made to keep the piles longer than the width of the structure to result in the formation of a lowered "bulb-of-pressure" that will greatly reduce settlement. The piles reduce the intensity of pressure acting on the ground and shift the zone of maximum stress to their lower portions.

Since the effect of the depth of the foundation on the bearing capacity of the ground depends not on the depth but upon the ratio between the depth and width of foundation, the effect of transferring pressure to a deeper level may be quite important in cases such as shown in Fig. 5. Under structures much wider than the pile lengths the bulbs are apt to be nearly the same with or without piles. Actually the use of piles in such cases often remolds cohesive soil and may help cause settlement.

Don't trust pile formulas

No pile-driving formula provides any indication of the ultimate settlement when piles are driven into soft cohesive soils. If a driving formula is depended on in such cases, settlements are sure to follow. This is because there is no relationship between the resistance of such soils to a sudden blow and to a continued pressure. Time is necessary for settlement. This often-ignored fact is the cause of many piles being driven in clay to a specified formula resistance, satisfying everybody at the time, while actually insuring later settlement.

There are several circumstances that may cause high driving resistance to be falsely indicated. Some of these are not widely known, due perhaps partly to the lack of contact that exists between the engineers, who may or may not always be familiar with the latest accepted pile-driving theories, and the field engineers and pile-driving foremen who may not always be aware of the seriousness of the effects of these conditions upon the desired results. If these conditions were more widely known to engineers, it would be possible for them to watch for them or insert preventative clauses in the specifications.

The use of a light hammer has been mentioned. It is a prolific cause of securing falsely high indicated resistance. If a double-acting hammer is used, it is common practice not to report reductions in speed of the hammer due to reduced steam pressure. This reduces enormously the net energy of the hammer available for penetration of the soil and may result in piles shorter by many feet than those actually needed, which may greatly increase the probabilities of settlement.

Another practice is to throw soft wood into the cushion cup. If the set is so reduced temporarily by this absorption of energy that it meets the resistance specified, driving is stopped.

Hammer blow reduced

Sometimes the stroke of the hammer has been shortened due to changing the ports. This is almost never noticed, as very few specifications call for measuring the stroke. The author has encountered this condition several times. Also, almost any single-acting hammer can be, and often is, slowed down by the operator, reducing the stroke several inches. Strokes are often very variable, within these few inches, depending upon the interest and attention of the operator. These reductions in stroke are of particular importance if the hammer is a bit on the small side for the service—for instance, if only 25 percent of the gross energy at full stroke is available as net for driving, and the stroke can be reduced 10 percent, the net driving energy may be cut in half or almost disappear.

An unscrupulous method in this class is to reset the slide bar on the hammer, so that a large back pressure will be present, thus greatly reducing the actual penetration of the pile under each blow. This plan has been used on a job having several rigs so that a foreman could establish notable daily driving records.

If driving is stopped for a few min-

utes after attaining a certain depth a temporary seizing of the pile will occur, which, if the set is read immediately upon resumption of driving, may indicate that it is not necessary to drive any deeper to meet the set specified. In such cases the set sometimes is read as soon after the start of redriving as possible.

Usually, within 2 or 3 ft. after the resumption of driving, resistance falls off to what it was before the stoppage. No criteria for final stoppage of driving should be applied until this has happened. The longer the interval of stopping, the greater the set-up is apt to be, although considerable set-ups are often obtained with very short stops. These stops should be reported on the pile inspector's reports, and if numerous, the engineer should scrutinize the driving procedures in an attempt to reduce stoppages or establish criteria for continuation of driving on such piles.

When driving spliced piles "acceptable" sets have been reported as those occurring on the redriving after the top section has been added, even though less than values obtained by driving single length piles.

Sequence of driving can affect set values materially. Sometimes the outer piles of a group are driven first, so that the inner ones "fetch up" to the specified sets at much higher elevations than the outer ones, due to compaction of the ground.

Load tests

After piles are driven to a sufficient depth to provide friction values in line with past experience for similar soils and to a specified driving resistance it is advisable to perform load tests. On a project of any magnitude tests should be made prior to pile driving operations, and on very large projects a test program should be carried out prior to taking bids on pile driving for the structure. However, settlements during load-testing sometimes do not represent settlements that will occur under the structure due to the non-standardization of load test requirements, methods of making tests and interpretation of test results.

For example, a load test on cohesive materials has no relation to the final settlement of the structure. This fact is not generally known and is hard for the layman to believe. The engineer usually will have trouble convincing the owner that such is the case. The concept of "bulb-of-pressure" around a single pile, compared with the overlapping of these bulbs in piles in a group or under the whole building, often is not considered. The fact that settlement under a building will continue for years, while the load test is temporary, frequently is overlooked.

Fig. 4. Proper capping of the pile head to protect it from water entering at the top assists in preventing decay of the pile and subsequent settlement of the load being supported.

If a bed of firm cohesionless material occurs above a deep soft stratum the test load on a single pile (Fig. 6) will distribute itself over a large area of the soft material and may show almost no settlement during the time of the test, while a load on the entire area of the structure over the years will show large total settlements and give differential settlements that may well force abandonment of the building. Consider the analogy of the snowshoe.

Excavation and fill

Sometimes the basic design may include excavating a basement that can partially or wholly compensate for the weight of the structure to be erected and thus avoid settlement by not increasing the load on the soil. This plan was used by Rennie about 150 years ago, before the evolvement of the science of soil mechanics, but fell into disuse through lack of understand-

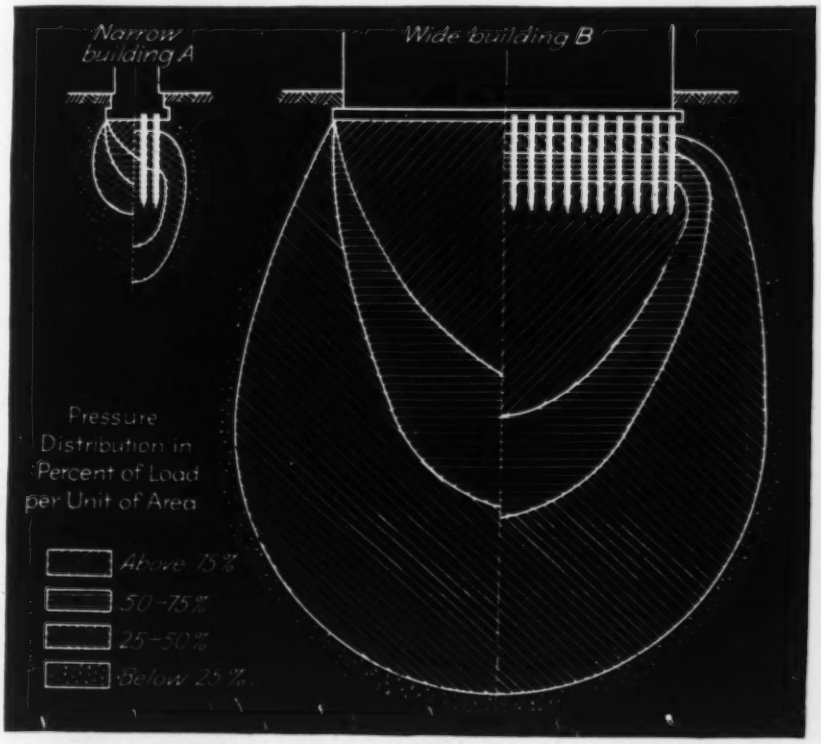


Fig. 5. Relative conditions of soil loading under a narrow building, A, and a wide building, B, with and without piling. Note difference in pressure bulbs.

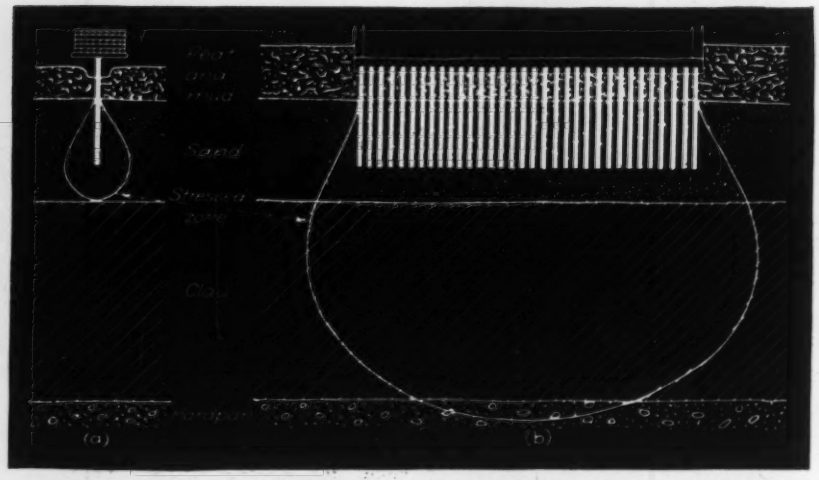


Fig. 6. The fallacy of basing design on the action under test of a single pile is illustrated by a study of the stressed zones. Under the single test pile the clay carries practically no load while under the completed structure it is heavily loaded.

ing of the principles. Soil mechanics experts have explained the theories involved in this method, which is particularly adaptable to heavily loaded areas underlaid by soft strata so deep that long piles are very uneconomical.

The presence of a bed of fresh or fairly recent fill over the site, if soft strata are below, will produce rapid settlements unless the site has been previously consolidated by a greater overburden in the past. It is rare that the added load from the fill, gripping the pile from the firm upper stratum when the lower stratum below consolidates, is considered. Some very expensive settlements have resulted from failure to allow for this condition.

Other causes of settlement

The above general principles may successfully be applied but there are also many special conditions which may occur on particular jobs.

The use of uncased poured-in-place concrete piles in hard ground will sometimes allow the green concrete to be damaged from adjacent driving. If enough of this occurs settlement may occur only on certain footings. If cored holes are used for uncased poured-in-place piles in soft ground soil may fall into the hole, completely cutting the pile shaft, with dangerous results. Sometimes shells used for piles are so thin that they will be collapsed, torn or crushed under hard driving.

Heaving or uplift of piles while driving adjacent units is an occasional cause of subsequent foundation settlement. Clusters should be checked to see if lift occurs and if it does should be carefully corrected by redriving to good bearing.

Incomplete filling of pile shells sometimes occurs, especially if reinforcing steel is present. Avoiding a dry mix, placing in small quantities and careful puddling aids in such cases. The total quantity of concrete placed compared to the computed volume of the shell will serve as a final check.

A method sometimes used, which saves pile footage but will increase settlements, is to drive the outer piles in a group first. Compaction makes the inner ones "take up" at a higher elevation.

Wood piles also have special causes of settlement. Permitting untreated wood to extend above groundwater level, present or future, will invite decay. This may result in the structure standing without settlement for 10 or 15 years and then settling suddenly. Insects feeding on wood have also been known to cause this difficulty.

In sea water, many kinds of marine borers destroy piles. Wood refuse dumped in the harbor encourages borers to breed. Raw sewage has kept borers down in many of the large East Coast harbors but as the waters are cleaned up by treatment of sewage increased difficulty can be expected.

Creosote treatment helps to prevent attack by borers but if the thin creosoted shell formed on treated piles is punctured by hooks or peavies during handling and driving, and if holes are bored or cuts sawed after treatment, life will probably be only $\frac{1}{2}$ to $\frac{1}{10}$ of that otherwise obtained. For a list of the things not to do if you wish to avoid rapid reterioration of treated wood piles consult the recent *Specifications for Field Treatment of Wood Piles* of the American Wood-Preservers Association. Unfortunately, common practice is to disregard these rules.

The use of composite piles is an excellent method of preventing settlements due to decay or insects as the concrete sections are impervious to these attacks. But to be effective, the concrete section must be carried to a few feet below the mud line as borers will go down two or three feet, and scour sometimes exposes the lower wood section.

Support of adjacent structures

A most important and quite frequently overlooked item in constructing foundations is prevention of damage to adjacent structures incident to the new work. Movement and settlement may be caused by removal of lateral support of piles during excavation and by vibration from driving. The repairs of buildings settled by adjacent work have sometimes cost as much as the original structure, and court records show many cases of high damage claims paid by the contractors or owners of the new work. Of course, the abutting owner wants everything redone in better than new condition.

In addition to care in maintaining support there is great value in an accurate survey and notes, as well as detail photographs, of the condition of adjacent structures *before* construction begins.

It is probably that most settlements of pile foundations result from a lack of understanding of the basic principles involved. The cost of piles for a foundation usually is a relatively small percentage of the total cost; the cost of adequate subsurface exploratory work, and the increased cost to obtain piles of adequate length and number to reduce settlement to reasonable or negligible amounts can be but a very small percent of the cost of the structure. Thus it would seem to be self-evident that such investment is warranted.

Articles on Piles and Pile Foundations by Mr. Chellis to appear in early issues are: Part II—"Field Determination of Damaging Stresses During Driving" and Part III—"Making and Interpreting Pile Load Tests".

Blasting Submarine Coral

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CHANNELS up to 45 ft. in depth were opened up through coral reefs in Samar, P. I., without the aid of drilling or dredging equipment, by the "surface blasting" method adapted by Seabees to the requirements of this particular location. Though admittedly requiring more explosive, the method of placing the charges on the surface of the submerged coral is effective and can be used even in fairly deep water as described in the following.

In applying this method at Samar, not only was it necessary for the blasting operations to break up the coral but also to move the fragments off into deep water. Varying in size from small pinnacles 20 ft. in diameter to deposits of 180,000 sq. ft., the reefs were covered with from 20 to 40 ft. of water. It was necessary to clear to depths of 45 ft. in some places to provide for floating drydock operations.

Equipment used

Exploratory work and placing of the charges was done from a self-propelled 3x7-ft. pontoon barge on which was mounted a 210-cu. ft. per min. compressor for diving work. The compressor was equipped with a charcoal filter, water trap and 12-cu. ft. accumulator tank. Diving masks were converted Mark III and Mark IV Navy gas masks. A T-fitting replacing the cannister was connected to a valve by a 3-ft. length of hose. The valve was attached to a web cartridge belt filled with lead and weighing about 30 lb.

The explosive found best suited to these operations was 60 percent dynamite. This charge has sufficiently high velocity and strength to propagate well under water, it does not deteriorate rapidly under water, and it is slow enough to have a heaving effect. The 60 percent dynamite was not always available, requiring the use at times of 40 percent with poorer results. It was necessary to use some condemned dynamite (part of which was more than two years old), making the operation more hazardous and the results less certain.

The shots were detonated by propagation from a single primer placed at one end of the charge and fired by a manual blasting machine. Two caps (usually No. 8) were used so that if one was ineffective the charge might still fire.

Charge pattern

The pattern of the shots varied with the size and shape of the reef. Nearly all the reefs rose from 18 to 24 ft. from the bottom, making it possible to slough coral off the reef with the shot without leaving broken coral to be removed by some other means.

On reefs less than 60 ft. wide, a line of 50-lb. boxes of dynamite 5-ft. apart (about three tons to a shot) was placed on each side about 15 ft. in from the edge of the reef. This would cut the edge in beyond the line of the powder boxes, leaving the top of the reef peaked. The second shot was placed in a single line 10 to 15 ft. from the crown and would shear the top off. If additional blasting were necessary, the same sequence was followed, cutting down the edges and shearing off the top.

On reefs of greater width, the foregoing procedure was modified in order to be sure of moving all the material clear of the reef. After cutting down an edge, a second charge was placed at the reef edge to blast a shelf below grade. Successive edge shots were used to throw material into shelves thus blasted. More dynamite was used per yard of coral moved on wide reefs than on narrow reefs.

Small reefs often were priority jobs. To save time, the reefs were overloaded with two side charges and a heavy crown charge, usually knocking down the reef in one shot. About twice the dynamite per yard of coral was required by this method as compared with a series of two or more blasts.

Small pinnacles, 20 to 30 ft. across, were removed with a single charge wherein the boxes of dynamite were placed in a semicircle around one edge of the obstruction.

For deep water blasting, the following results were attained in a 6-month period:

Coral removed	423,300 cu. yd.
Dynamite used (all types)	1,767,250 lb.
Dynamite used per cubic yard	4.18 lb.

The blasting operations described in the foregoing were undertaken primarily because of lack of dredging equipment. They were not as efficient nor as rapid as dredging operations would have been. The main advantage was that such blasting operations were quickly organized both in equipment and personnel. The blasting unit was able to remove reefs which were too small for efficient dredge operation and would also operate in water too deep for dredges.

Expanding cement used to repair concrete bridges

Bomb damaged concrete bridges of the S.N.C.F. (French National Railways) are being repaired by the use of "expanding" cement as a means of introducing compression into the members. An arch structure at Epinay-sur-Sine, repaired by this method is described in the Oct. 15, 1945 issue of *Le Genie Civil*. No information on the cement used is given, but it is assumed to be of the alumina type.

The Epinay arches are of 38.5 meter span and 1.35 meter thick at the center. One of these arches, hit by a bomb during Allied air raids in 1944, was pierced and shattered for more than one-half of its width. The damage was so serious that three auxiliary arches extending from the abutments out to and beyond the point of damage were constructed under the soffit of the main arch. These arches were preloaded up to about 100 tons by the use of a jack acting at the center.

With the three auxiliary arches in place, repair of the main arch was begun. The width of the arch was divided into five segments, each one meter wide, and concrete placed first in one of the side segments, then in the center segment, then in the far side segment and then in the two intermediate segments. At the center of the hole expanding cement was introduced, while away from the actual center of damage ordinary portland cement was employed.

Columbia Basin Project Starts This Year

Frank A. Banks
Supervising Engineer, Columbia Basin Project

***Contents in Brief**—Work will start this year on twelve major features of the 1,000,000-acre Columbia Basin irrigation project, which includes the world's largest pumping plant, earthfill dams, 9 main canals, 46 siphons, and 4 tunnels. The pumping plant, partially completed as a portion of the work on Grand Coulee Dam, will ultimately contain twelve 1,350-cfs. pumps, contracts for four to six of which are to be let shortly.*

WITH SUPPLEMENTAL FUNDS of more than $10 million recently granted by Congress, construction will begin soon on the largest single land development of the Bureau of Reclamation, the Columbia Basin irrigation project of south-central Washington. The project is a coordinated system of pumping plants, dams, canals, siphons, and related works designed to serve more than 1,000,000 acres of fertile but dry land in the Big Bend region of the Columbia River.

Twelve major features of this project will be started during 1946 which will carry water from the immense Grand Coulee Dam to the Southern reaches of the Columbia Basin, 150 miles away. Present schedules allow ten years to complete the project.

An example of the large quantities of materials to be used in building the system is the amount of earth and rock to be moved (135,000,000 tons), six times greater than the 21,000,000-ton bulk of Grand Coulee Dam, key feature of the development. Some 125,000,000 man-hours of on-site employment will be involved in the construction program.

Many structures involved

Relation of the various parts of the project is shown in Fig. 2. These parts are outlined in the following, beginning at the point of diversion from the reservoir.

The world's largest pumps are to lift water from the reservoir behind Grand Coulee Dam to the abandoned ice-age channel of the Columbia River known as the Grand Coulee. In this coulee an equalizing reservoir will be formed by North Dam and South Dam, two earth-and-rockfill dams 27 miles apart. The Grand Coulee equalizing reservoir will provide most of the water for the project.

From the southern end of the Grand Coulee equalizing reservoir, water will be carried through the lined Main Canal, the Bacon Siphon, the Bacon Tunnel, Trail Lake, and a natural channel to Long Lake, at whose southerly end the Long Lake Dam will be built.

The Main Canal then will lead from Long Lake Dam to bifurcation works 6.6 miles away, near the town of Adrian, where the canal will branch into the West Canal and the East Low Canal. The 78-mile West Canal will serve 280,000 acres in the westerly portion of the project. The East Low Canal is the longest in the project (138 miles) and will be designed to serve 252,000 acres in the easterly portion of the basin.

Near the central area of the proj-

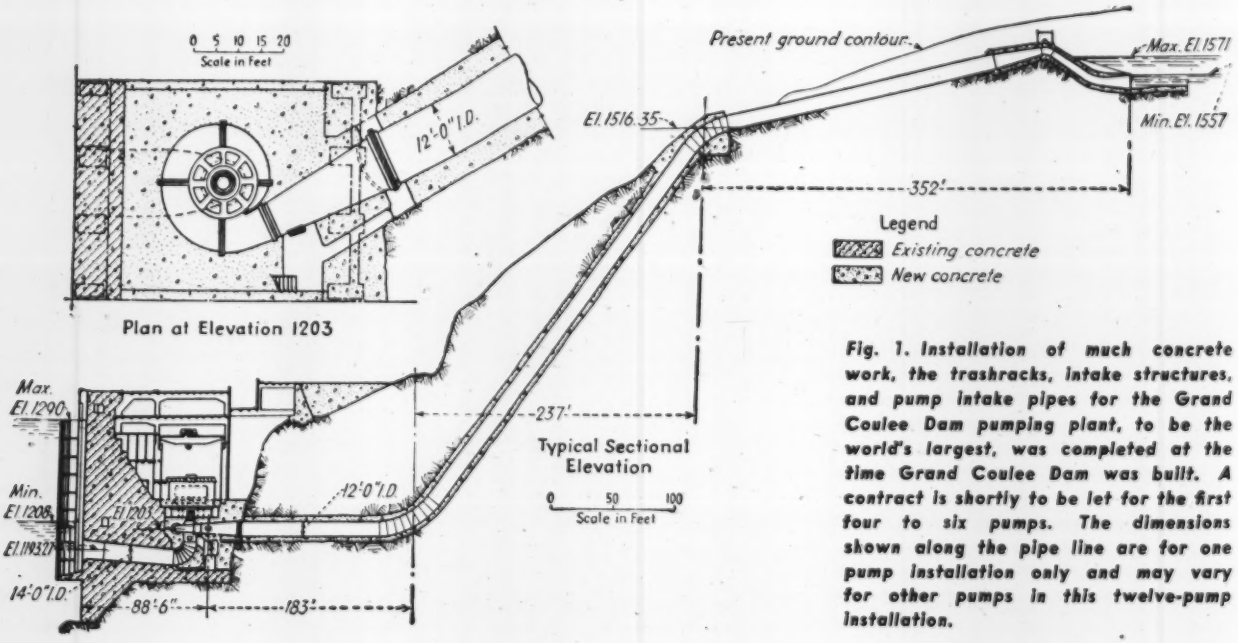


Fig. 1. Installation of much concrete work, the trashracks, intake structures, and pump intake pipes for the Grand Coulee Dam pumping plant, to be the world's largest, was completed at the time Grand Coulee Dam was built. A contract is shortly to be let for the first four to six pumps. The dimensions shown along the pipe line are for one pump installation only and may vary for other pumps in this twelve-pump installation.

ect, the Potholes Dam (earth-and-rock-fill with 15,000-ft. crest length) will be built to capture seepage and return flow from the surrounding irrigated land and also to reduce pumping costs at Grand Coulee Dam. Leading from the Potholes Dam will be the 16-mile Potholes West Canal, designed to carry sufficient water for about 14,000 acres, and the 51-mile Potholes East Canal, designed to serve 254,000 acres.

Since it will be several years before water from the canal system reaches the southerly portion of the project, a temporary pumping plant will be installed on the Columbia River about 12 miles northwest of Pasco. With a lift of 177 ft., this plant will serve about 6,000 acres of land. At the time the Potholes East Canal is completed (toward the end of the ten-year period scheduled for the entire project), the pumping plant will be abandoned.

A permanent pumping installation on the south side of Snake River, the Burbank plant, will serve acreage in the most southerly portion of the basin. Construction will be delayed until final plans for the Umatilla Dam (a proposed navigation, power, and irrigation project under the jurisdiction of the U. S. Army Engineers located on the Columbia River near Umatilla, Ore.) make it possible to determine how much land will be inundated and what the pumping head will be.

Instead of using the natural channel between Trail Lake and Long Lake, a dike is planned at the southerly end of Trail Lake, the water to be carried in a diversion canal to a 165-ft. power drop where it is to plunge into Long Lake. At the forebay of the Long Lake power plant the East High Canal is to branch toward the east and extend for 110 miles along the eastern fringes of the project to serve 215,000 acres. Construction of the East High Canal is being deferred because it is to serve an area now devoted largely to dry-farm wheat growing. The Long Lake power plant is also planned for later construction.

The availability of men, materials, and equipment will be the guiding factor in determining the construction progress made on the Columbia Basin project during this year. With the exception of the pumping plant at Grand Coulee Dam and the 16,000-cfs. feeder canal leading from the pumping plant outlet to the North

TABLE I—ELEVATIONS OF WATER SURFACES AT SIGNIFICANT POINTS

Pumping plant	Feet Above Sea Level
Intake—max. res.	1,290
min. res.	1,208
Discharge—max res.	1,571
min res.	1,557
Grand Coulee reservoir	1,570
Trail Lake	1,507
Long Lake	1,335
Potholes reservoir	1,052
Pasco	400

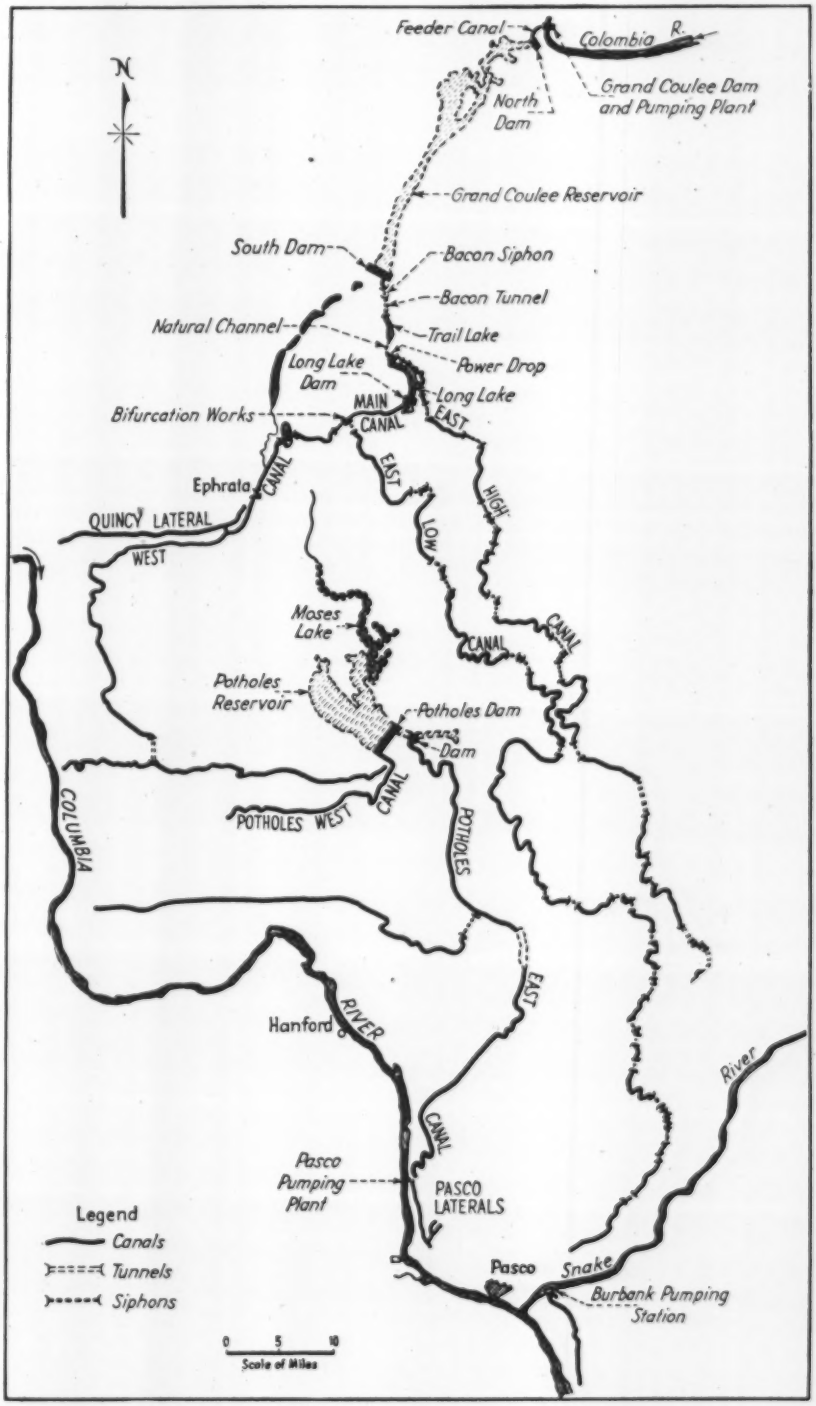


Fig. 2. Using water impounded by Grand Coulee Dam, the Columbia Basin irrigation project will irrigate the largest single land development of the Bureau of Reclamation. Major features to be contracted for in 1946 include the South Dam, Long Lake Dam, Main Canal, Potholes Dam, West Canal, East Low Canal, Pasco laterals, Pasco pumping plant, three siphons and one tunnel.

TABLE II—DATA ON FOUR MAIN FEATURES, COLUMBIA BASIN PROJECT

Four Earth-Rock Fill Dams

Dam	Height (feet)	Length (feet)	Volume (cubic yards)
North Dam	90	1,360	1,100,000
South Dam	63	9,880	1,400,000
Long Lake	100	1,650	1,000,000
Potholes	110	15,000	12,000,000
			15,500,000

Four Tunnels

Canal and Tunnel	Length (feet)	Diameter (ft.-in.)	Excavation (cubic yards)	Supports: Steel (tons)	Supports: Timber (mbf.)	Concrete Lining (cubic yards)
Main Canal						
Bacon Tunnel (twinbore)	19,000	23	376,000	3,922.5	1,800	77,800
West Canal						
Low Gap Tunnel	9,150	16	91,605	1,300.5	600	21,200
East Low Canal						
Dunningan Tunnel	2,000	11	9,460	107.5	90	2,700
Potholes East Canal						
Soda Lake Tunnel	4,000	22	69,000	750	340	14,800
Total	25,150		546,065	6,080.5	2,830	116,500

Forty-six Siphons

Canal	No. Siphons	Total Length (feet)	Diameter of Siphons (ft.-in.)	Concrete (cubic yards)	Struc. Steel (tons)	Reinf. Steel (tons)	Excavation (cubic yards): Earth	Excavation (cubic yards): Rock
Main	1[1]	1,013	23–3	13,000	.....	2,000	3,000	2,000
West	5	32,350	18–3 to 24–6	91,000	23,600	7,705	282,000	73,000
West Laterals	4	16,350	6–2 to 12–0	22,000	290	2,655	57,000	57,000
East Low	30[2]	70,230	7–0 to 16–2	175,000	21,385	13,505	616,000	210,000
Potholes East	2	2,600	8–0 to 20–0	5,000	.....	500	23,000	3,000
Potholes East Laterals	4	24,780	5–9 to 17–3	16,000	13,450	460	41,000	6,000
Totals	46	147,323		322,000[3]	58,725	26,825	1,022,000	351,000

[1] Double barrel. [2] Includes 19 double-barrel siphons. [3] Includes barrels, piers and anchors.

Nine Main Canals

Canal	Length (miles)	Excavation (cubic yards): Earth	Excavation (cubic yards): Rock	Rolled Embankment (cubic yards)	Concrete (cubic yards)
Feeder	1.6	614,800	665,700	65,000	30,000
Main	13.1	1,230,200	2,805,800	624,800	106,000
West	78.3	9,769,700	1,763,800	987,600	361,600
West Laterals	56.9	916,900	216,500	256,700	178,800
East Low	137.7	19,567,200	4,639,300	2,768,300	499,000
East Low Laterals	41.7	622,100	71,500	143,000	119,000
Potholes West	16.2	175,100	287,800	79,700	41,000
Potholes East	51.6	4,096,000	3,485,900	1,653,200	366,500
Potholes East Laterals	78	4,142,500	721,500	837,200	401,700
Total	475.1	41,134,500	14,657,800	7,415,500	2,103,600

TABLE III—GRAND COULEE DAM PUMPING PLANT

Pumps (vertical shaft, single impeller, single suction)
- Total (ultimate) 12
- Initial contract ..... 4 or 6
- Head variation ..... 270 to 365 ft.
- Capacity (each): 310-ft. head ..... 1,350 cfs.
- 365-ft. head ..... 800 cfs.

Motors (synchronous, direct connected)
- Power output ..... 65,000 hp.
- Voltage ..... 13,800 volts
- Speed ..... 200 rpm.

Intake pipes (I.D.) ..... 14 ft.

Discharge pipes (I.D.) ..... 12 ft.

Major construction quantities
- Concrete ..... 81,000 cu. yd.
- Reinforcing steel ..... 6,937.5 tons
- Rock excavation ..... 2,500 cu. yd.
- Cement floor finishing ..... 125,000 sq. ft

Dam in the Grand Coulee equalizing reservoir, all construction will be under private contract. During the year the Bureau of Reclamation hopes to let contracts for initial work on the South Dam, Long Lake Dam, Main Canal, Potholes Dam, West Canal, East Low Canal, Pasco laterals, Pasco pumping plant, three siphons, and one tunnel. Other work tentatively scheduled for this year is a headquarters building at Ephrata and initial work on the relocation to higher level of the state highway in the Grand Coulee. This requires 28 miles of new road. The Washington State Department of Highways will handle highway contracts.

One of the major features of the project is the pumping plant, the world's largest, located adjacent to the left abutment of Grand Coulee Dam. The base for the pumping plant had to be built before the reservoir was flooded. Similarly the rock tunnels for the outlet pipes from the pumps had to be driven before final grouting of concrete and bedrock. The plant is located behind a gravity "wing" dam, similar in general design to Grand Coulee Dam. Through this wing dam pass the intake pipes that deliver water from the reservoir to the pumps. Trashracks, intake structures, and pump intake pipes are now in place.

Pumps will lift water from the reservoir behind Grand Coulee Dam (Lake Roosevelt) into the feeder canal against a total dynamic head of 270 to 365 ft. Each of the pumps will be driven by a 65,000-hp., direct-connected, 13,800-volt, synchronous motor, which will run at 200 rpm. Two such motors will be driven by one 108,000-kva. generator in the west powerhouse of Grand Coulee Dam. Provision is made for the eventual installation of twelve pumps, two to be held in readiness for emergencies. Installation of the first pump is scheduled to begin early in 1948. The pumps are to be vertical-shaft, single-impeller, single-suction, centrifugal type to deliver not less than 1,350 cfs. under a dynamic pumping head of 310 ft. at 87 percent efficiency, and not less than 800 cfs. under a 365-ft. head.

A contract for the first four to six pumps will be let this year with installation to be started early in 1948. Pump motors will be under a separate contract to be let at a later date.

Lighting for Night Construction

EXTENSIVE experimental work by the Engineer Board at Ft. Belvoir, Va., to provide better lighting for night construction on war projects has included development of improved floodlighting units that offer advantages for peacetime construction.

Tests showed that floodlights, to be most effective, should be supported at least 25 ft. above the ground. To meet this requirement, a special tripod 25 ft. high supporting three 115-volt. 750-watt floodlights was built. The tower, which weighs only 52 lb., has telescoping legs and may be assembled in a few minutes. One leg of the tripod is hinged at the top to permit raising by the method shown at left in Fig. 1. Steel stakes 12 in. long are driven through the base of each leg to tie the tower down and make it difficult to tip over.

The experimental work has also shown that where a commercial power supply cannot be used, a satisfactory power source is a 5-kw. gasoline-driven generator. This unit is of sufficient size to provide power for six 750-watt floodlights

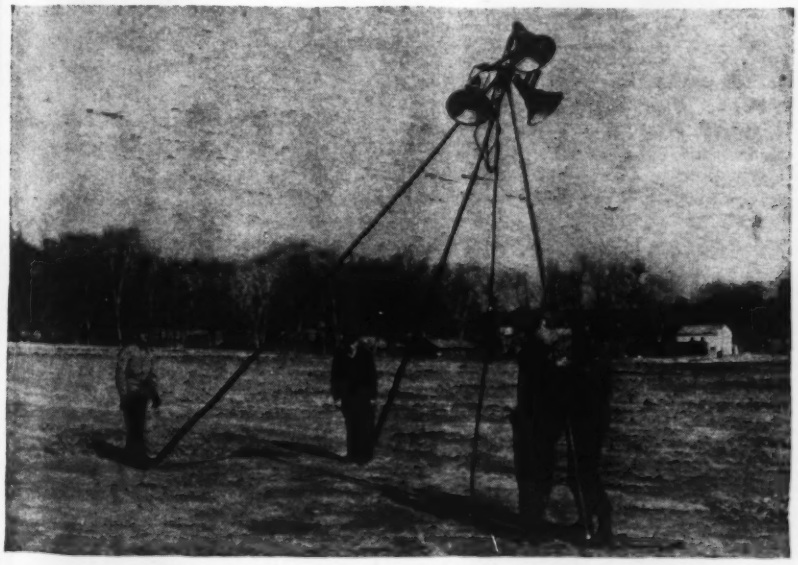
Telescoping mast

Engineers at Ft. Belvoir also have built a special mast for supporting a set of four 1,000-watt lights above an 8-kw. portable plant (Fig. 1 right). The mast is of telescoping design and may be readily extended by one man, by means of a rack and gear, to support the lights at a 25-ft. level. The mast is hinged at the base and when not in use is retracted and tilted back where it is supported on a bracket along the side of the power plant.

A somewhat similar auxiliary mast, designed to be supported independently of the portable plant, is equipped with four legs that provide the necessary stability. It is connected to the power plant by means of two conductors of No. 8 neoprene-jacketed cable having molded connectors. It is telescoped for transporting and carried on the opposite side of the plant housing.

The eight floodlights and accessories, when not in use, are stowed in a compartment provided above the trailer-mounted power plant.

The lighting units were developed in cooperation with General Electric Corp. Maj. O. P. Cleaver, chief of the electrical engineering branch of the Engineer Board, was in general charge. C. F. Cashell was in direct charge of much of the work.



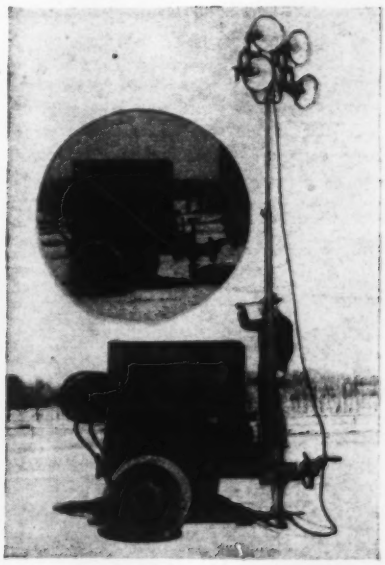


Fig. 1. One leg of the telescoping tripod is hinged at the top to permit easy raising. Steel stakes 12-in. long are driven through the base of each leg to tie the tower down. Right: An 8-kw. portable power plant is equipped with a telescoping mast which is easily raised by one man. Space is provided above the gasoline-driven generator for storing flood lamps. Insert shows unit ready for towing.

"Controlled-Conditions" Buildings Compared With Conventional Factories

Contents in Brief—*Strong, economic justification may be found in some cases for design of an industrial building in which light, temperature, humidity and other factors affecting efficient operation are always under full control. This type of structure is more expensive to construct and operate than the usual plant but savings through increased production, improved quality of products and better labor relations may offset these extra construction costs.*

A NEW TYPE of industrial building, known as a "controlled-conditions" plant, has come to the fore in recent years. Among its outstanding characteristics are walls with virtually no windows and mechanical control of temperature and humidity. While such buildings are more expensive to construct and operate (Table I), they have advantages over conventional structures to warrant their adoption under certain conditions.

In a recent economic and engineering study on the question: "Why a controlled conditions plant?" The Austin Company, engineers and builders of Cleveland, Ohio, analyzed these advantages and called attention to the need for study of each proposed structure to determine whether this new type is economically justified. The following is based upon information in The Austin Company report.

The controlled-conditions plant was developed to overcome shortcomings of conventional structures in special situations (Fig. 1). While industrial plants of usual design have been continually improved, some fail to provide the ultimate in uniform operating and working conditions, in flexibility for meeting varying production demands economically, straight-line production, uniform light of proper intensity and quality, uniform atmospheric conditions, proper sound control and other desirable features (Table II).

On the other hand, in a controlled-conditions building the principal conditions affecting efficient operation—light, temperature, humidity, noise and proper ventilation—are under full control and independent of the natural sources. Ideally, it should provide at all times conditions comparable to "a rare day in June," with constant ideal temperature and constant ideal humidity, and light free from glare throughout the entire working area. All working conditions are under full control at all times, rain or shine, winter or summer.

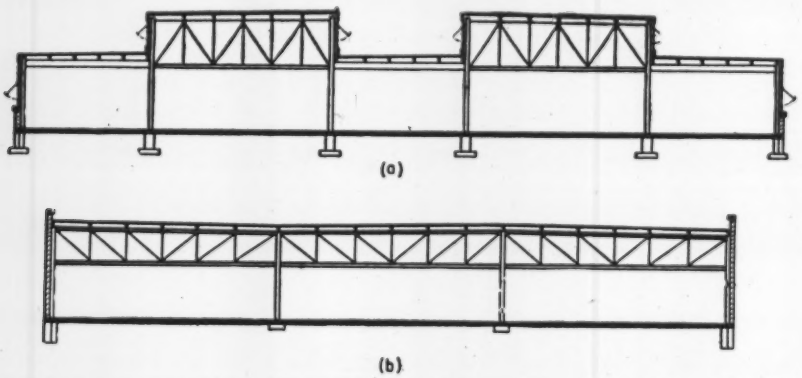


Fig. 1. One-story factory of conventional type (a) utilizes side wall and monitor sash to provide light and air, whereas the interior of a "controlled-conditions" plant (b) is entirely independent of external conditions. In the latter structure space between trusses may be utilized for installation of mechanical equipment, such as air conditioning apparatus.

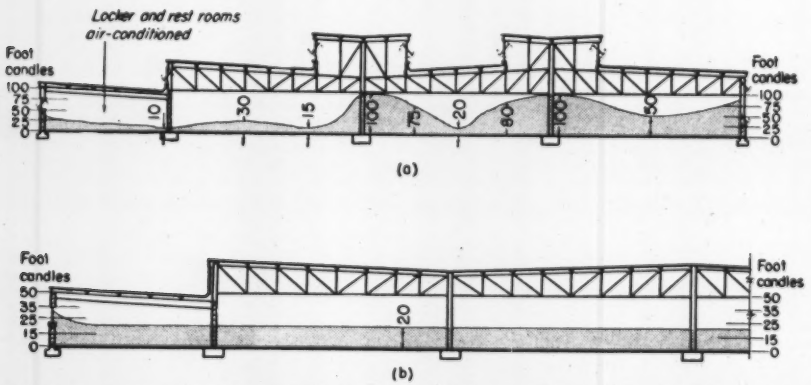


Fig. 2. Illumination can be controlled at a uniform level in a "controlled-conditions" plant (b), whereas daylight varies in intensity throughout a conventional building of the same occupancy (a).

Methods of obtaining good light

The quality of light is very important in industrial buildings. Good quality results when uniform illumination without glare and of adequate intensity is provided.

Natural lighting secured through the use of modern side wall sash, monitors (Fig. 2*a*), skylights and sawtooth roofs have not solved the problem of heat, glare and hourly or daily variation in light intensity. While the sawtooth design provides even distribution of daylight with sash facing north so that glare is eliminated on bright days, not enough natural light

TABLE I — COMPARISON OF CONSTRUCTION AND OPERATING COSTS

New Jersey Plant—High Concentration of Machinery and Employees

Construction Costs — Items	Conventional	Controlled conditions	Annual Operating Costs and Fixed Charges (Per sq. ft.) — Items	Conventional	Controlled conditions
1. Superstructure	63%	62%	[1] Fixed Charges	$0.34	$0.44
2. Plumbing and Drainage	6	5	Maintenance —		
3. Heating, Ventilating or Air Conditioning	6	17	Superstructure	0.05	0.02
4. Lighting	10	10	Operation and Maintenance —		
5. Power Wiring	3	3	Heating, Ventilating or Air Conditioning Equipment	0.23	0.38
6. Sprinkler	3	3	Electric Lighting	0.09	0.09
7. Boiler and Cooling Plant	9	21			
Totals	100%	121%		$0.71	$0.93
Operating cost per man-hour, based on two 8-hour shifts				2.1¢	2.7¢

Above data based upon; (a) an actual conventional plant constructed in 1941; (b) a hypothetical "Controlled Conditions" Plant of the same floor area and clear working height; (c) a total manufacturing area of 306,000 sq. ft. (285,000 air conditioned) and (d) two eight-hour shifts of 2,500 employees for 275 annual working days.

Indiana Plant—Medium Concentration of Machinery and Employees

Construction Costs — Items	Conventional	Controlled conditions	Annual Operating Costs and Fixed Charges (Per sq. ft.) — Items	Conventional	Controlled conditions
1. Superstructure	67%	65%	[1] Fixed Charges	$0.27	$0.39
2. Plumbing and Drainage	5	5	Maintenance —		
3. Heating, Ventilating or Air Conditioning	5	16	Superstructure	0.06	0.02
4. Lighting	11	11	Operation and Maintenance —		
5. Power Wiring	1	1	Heating and Ventilating or Air Conditioning Equipment	0.08	0.15
6. Sprinkler	5	5	Electric Lighting	0.07	0.08
7. Boiler and Cooling Plant	6	15			
Totals	100%	118%		$0.48	$0.64
Operating cost per man-hour, based on two 8-hour shifts				1.3¢	1.7¢

Above data based upon; (a) an actual conventional plant constructed in 1941; (b) a hypothetical "Controlled Conditions" Plant of the same floor area and clear working height; (c) a manufacturing area of 153,000 sq. ft.; (d) 1,200 employees for 275 annual working days.

Oklahoma Plant—Low Concentration of Machinery and Employees

Construction Costs — Items	Conventional	Controlled conditions	Annual Operating Costs and Fixed Charges (Per sq. ft.) — Items	Conventional	Controlled conditions
1. Superstructure	57%	54%	[1] Fixed Charges	$0.81	$0.97
2. Plumbing and Drainage	5	5	Maintenance —		
3. Heating, Ventilating or Air Conditioning	13	22	Superstructure	0.04	0.01
4. Lighting	9	10	Operation and Maintenance —		
5. Power Wiring	4	5	Heating and Ventilating or Air Conditioning Equipment	0.04	0.11
6. Sprinkler	None	None	Electric Lighting	0.19	0.21
7. Boiler and Cooling Plant	12	20			
Totals	100%	116%		$1.08	$1.30
Operating cost per man-hour, based on two 8-hour shifts				1.2¢	1.5¢

Above data based upon; (a) an actual "Controlled Conditions" Plant constructed in 1942; (b) a hypothetical conventional plant of the same floor area and clear working height; (c) a total manufacturing area 1,585,000 sq. ft.; (d) 25,000 employees for 275 annual working days.

[1] Fixed charges based upon 6% for interest on capital investment and depreciation apportioned on ten, fifteen and twenty years life of air conditioning equipment, boiler plant and building, respectively.

is provided on dull days. In cold climates, snowfall in the valley of the sawteeth may sometimes block off as much as 50 percent of the glass area, and unless proper precaution is taken, condensation will result regardless of the climate.

Though recent advances have been made by glass manufacturers, who have developed heat- and glare-reducing types of glass, it has been found difficult to overcome glare completely in conventional plants. Glass blocks may keep out dust and fumes from external sources, but in the summer they absorb and re-radiate heat. Use of multi-pane windows, The Austin Company says, does reduce heat loss, and with the use of polarized glass or venetian blinds, glare can be eliminated, but with a corresponding decrease in daylight intensity.

A satisfactory method of overcoming the vagaries of daylight is the use of a combination of daylight and artificial light, with the latter controlled by means of photoelectric cells so as to maintain a given lighting intensity. But this procedure would solve only the lighting problem. The windows would still permit heat loss in winter and heat gain and glare in summer. They would not keep out noises. Furthermore, as The Austin Company engineers point out, dirt and fumes can filter through conventional factory sash. Also to be taken into consideration is the expense of maintaining steel sash, including cleaning, painting and periodic caulking to insure water tightness.

With complete artificial lighting, in-

TABLE II—EFFECT OF PLANT WORKING AND OPERATING CONDITIONS

Condition	Affects Workers'	Effect on Production	Cost to Worker	Cost to Industry
Poor or variable lighting	Eyesight	Errors	Glasses	Scrap losses
		Reduction in quantity and quality	Fatigue	Low production schedules
			Headaches	Increased accident insurance premiums
		Accidents		Increased inspection costs
Uncontrolled atmosphere	Respiratory system	Absenteeism	Medical fees	Reduced output
		Reduced production schedules	Lost wages	Poor worker-employer relationship
		Spoilage of material		High rejection rate
Noise	Hearing	Errors	Hearing aids	Reduced output
		Reduced quantity	Nervous fatigue	Inefficient operation
		Accidents	and disorders	High accident premiums
				Temperamental and nervous workers
Other undesirable conditions including poor service facilities	Morale	Lost time	Disease	High labor turnover
		Reduced efficiency	Dietary deficiencies	Absenteeism
				Inability to attract good labor

dependent of external light sources, (Fig. 2*b*) as obtained in a controlled-conditions plant, illumination is uniform and control of glare is a relatively simple matter. Furthermore, good quality of light can be obtained at all times. Lighting intensities can be controlled to within two or three footcandles, whereas in a conventional plant, the variation may exceed 75 footcandles even when daylight is supplemented by an artificial lighting system (Fig. 2*a*).

Because of the tremendous increase in the efficiency of lighting devices and the decrease in cost of electrical energy in recent years, controlled-conditions plants can today be properly lighted for less than is being spent today to light many conventional plants, according to The Austin Company. This statement reflects the fact that more intensive use of floor space is made in controlled-conditions buildings and is based on recent surveys of conventional plants in which actual observation indicated that 90 percent of the lighting fixtures are in constant use, regardless of daylight conditions. In one case, where an owner built a completely new controlled-conditions plant, the cost of current decreased by one-third compared with the old plant of conventional design. Furthermore, when fluorescent lamp installations are used, more efficient operation is achieved when the lamps are operated constantly than when in intermittent use.

The amount of control exercised over ventilation and air movements in conventional factories sometimes leaves much to be desired. In the winter, temperature can be regulated in a conventional factory of good design and construction, but heating costs more than in a controlled-conditions plant, principally because of the large heat loss through windows. Furthermore, in the usual plant uncontrolled leakage through sash is relied upon to provide fresh air, whereas in the newer type of plant the input of adequate fresh air is controlled. In the summer, when temperature and humidity effect quality, efficiency and comfort most, the conventional plant offers little relief, while in the controlled-conditions plant temperature and humidity can always be kept at a desirable level.

Reduction of noise

Another important factor to be considered in industrial buildings is noise control, which may be most effectively accomplished by isolating and damping sounds at their sources and by use of sound-absorbing or dispersing surfaces for the walls and ceiling areas (Table III). With the use of various combinations of these basic methods, an appreciable degree of sound control may be secured in a conventional building, but best results, according to The Austin Company, both from the standpoint of cost and efficiency, are secured in a controlled-conditions plant.

Where outside noises present a problem, one solution is the use of

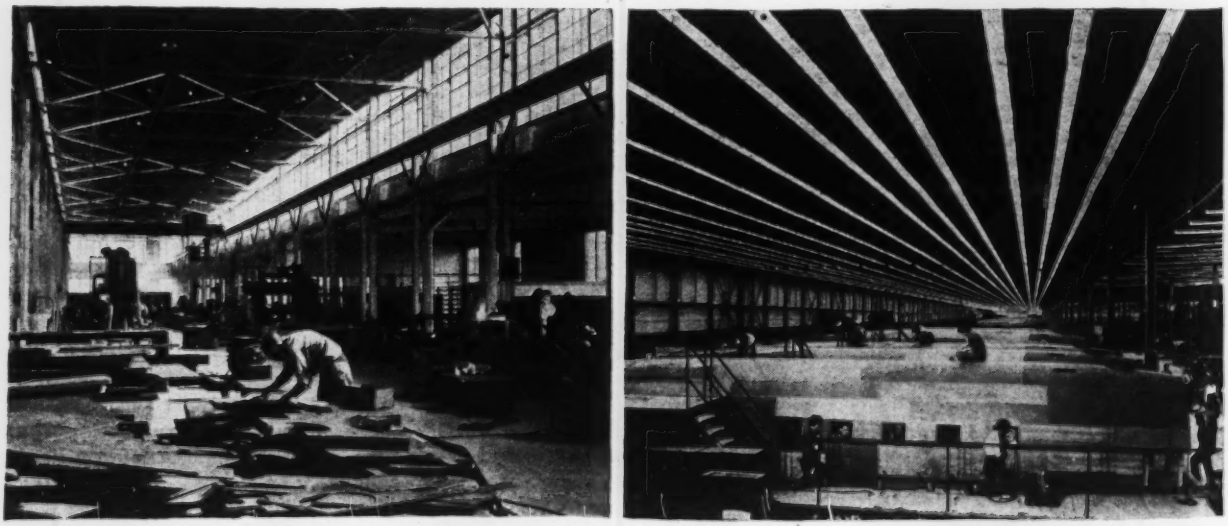


Fig. 3. Sharp shadows are formed in the interior of a conventional factory (left) on a bright, sunny day, despite unusually large areas of glass in side walls and monitors. In a "controlled-conditions" aircraft plant (right) 55 foot-candles of good quality light are provided uniformly throughout the working area.

side walls virtually without openings. Such walls are also readily adaptable to acoustical treatment for interior noise control. This can be secured at relatively low cost and is the only one of the major items of control that costs nothing to operate and maintain.

As a result of a comparatively recent development, the health of employees can be improved by using circulated air as an agent of medication by the introduction of bacteria-killing chemicals directly into the air stream. Air-borne bacteria can also be destroyed by the installation of germicidal air ducts and by direct application of ultra-violet rays to specific operations.

TABLE III—NOISE REFLECTION VALUES

Concrete	98.5%
Plastered walls or ceilings	97.5%
Glass windows	97.5%
Wood	94 to 97.0%
Metal	99.0%

Because of the possibility of controlling unusual atmospheric conditions, such as "hot spots," dust, and fumes, whenever they occur in a controlled-conditions plant, straight-line production that is actually straight can be achieved. Controlled atmosphere contributes to increased production and often permits a reduction in floor space.

The Austin Company points out that controlled conditions are not always economically justified. For example, in cases where employee density is low or where the product is not affected adversely by variable conditions, use of a conventional structure may be advisable. Competent engineering advice is needed to decide which type of structure should be built.

Old Rail Removed in 3-Ft. Pieces

Experience in removing old girder rail from paved streets in San Francisco showed that time and cost could be saved by a speedy means of breaking the rail into short lengths. The rail broke more easily, it is believed, because of its condition; it had been in service more than 30 yr. and was reported to be "in varying stages of advanced crystallization and base corrosion."

About 8 mi. of the rail, a 9-in., 106-lb. girder section, had to be removed in order that the streets could be repaved according to an agreement between the Market Street Railway Co. and the city. As the rail removed would be only scrap metal anyway, short lengths would not decrease the value but would reduce handling cost. Two methods of removal were used, one took out the entire rail; the other made a lengthwise cut in the web, leaving the lower part of the rail in place.

In the first method a narrow trench was dug along one side of the rail, spikes were drawn and the rail was barred and jacked sideways until it could be lifted bodily to the surface of the pavement. A few blocks or old ties were then placed under it so that it cleared the street surface and was ready to have notches burned through ball and flange at 3-ft. intervals with an oxyacetylene torch. After this had been done a 20-lb. sledge was used to strike the head of the rail near each notch. This would cause the rail to break through to the base usually after one heavy blow, though occasionally two or three were required. This work was done during cool, winter weather which doubtless aided in the breaking up process. It was pointed out that in hot weather results might not be so satisfactory.

On some 30,000 ft. of the rail only the upper 5 in. of the 9-in. rail height was removed, the lower part being left in place on the ties. This was made possible by burning through the entire length of the $\frac{7}{16}$-in. web with an oxyacetylene torch after a shallow trench had been excavated along one side of the rail.

Although remarkable speed was made in removing rail by this second method, it was not always possible to make a clean continuous cut through the rail web because of the backing of concrete on the far side. Because of this there were spots where the rail did not separate freely, hence some barring and jacking was necessary, or occasionally some of the bad spots had to be reburned.

A more serious difficulty, however, was the scarcity of burners who could and would do the work. Not only did it require a skilled burner but the work was very fatiguing because of the tiresome stooping position in which it had to be done. After the burners became accustomed to the work there was less complaint and a higher rate of speed resulted. Nevertheless, it was frequently impossible to keep as many burners on the job as were needed.

An average crew for rail removal was about sixteen men including one foreman, three to four pneumatic paving breaker operators and two to three cutting torch operators. This outfit excavated the trench, burned and removed the rails at an average speed of about 300 ft. of single track per 8-hr. day. At times the rate was 350 to 360 ft. per day. The trenches were filled and the surface was repaved by other crews.

The rate of burning the web longitudinally by the torch operators, after they became accustomed to the work, ranged from 30 to 47 ft. of rail per hour; the oxygen consumption was about 3.3 cu.ft. per ft. of rail and the acetylene consumption 0.75 cu.ft. When breaking up the upper part of the rail that had been cut off by the longitudinal web cut, it was necessary to make transverse cuts only through the remaining portion of the rail web. When the rail head near this cut was struck with the sledge it broke quite readily in most instances.

The labor cost of removing the rail exceeded the salvage of course and the work was done solely in order to comply with the city contract. Since the city did not object to leaving the lower portion of the rail beneath new paving; the cheaper method was to make the longitudinal web cut and take out only the top of the rail. However, the difficulty in obtaining burners made it necessary, in order not to slow up progress unduly, to use the trenching crews part of the time for digging out the entire rail sections while the few burners available were "catching up." The cost of the two methods did not differ greatly because the additional labor used in digging out the entire rail was partly offset by increased salvage from that operation.

On this job as a whole a total of 44,200 ft. of 9-in., 106-lb. rail was removed. The job was completed in about 70 working days by a crew ranging from 12 to 20 men.

Building a One-Mile Sewer by Tunneling

Contents in Brief—A 27 to 36-in. dia. sewer, one mile long, was built below the normal water table in a tunnel lined with timber in good soil and with metal plate in unstable ground, compressed air being used for some sections. Excavation was done with hand tools and the muck was hand-loaded into light-weight cars shuttled back and forth manually on a narrow-gage track. For speed and economy, concrete required within the tunnel was dropped down 6-in. dia. pipes installed at 50-ft. intervals along the sewer, use of a cement-dispersing admixture in the cement making this uncommon delivery method practical. Most of the several shafts required were lined with metal plate instead of timber.

USE OF METAL LININGS for small shafts and dropping concrete as much as 55 ft. through regularly spaced pipes to encase a mile-long sanitary sewer are innovations employed by Square Construction Co. on a recently completed job in Baltimore, Md.

The project consisted of 2,100 ft. of 27-in. dia. extra-strength vitrified pipe, encased in concrete, and 3,200 ft. of cast-in-place sewer varying in diameter from 30 to 36 in. The invert of the line is from 33 to 55 ft. below natural ground level and from 10 to 16 ft. below tide level in a nearby stream, so that the sewer was under water at all points. The sewer has a constant gradient of 0.15 percent.

The predominant soil encountered was an impervious sandy clay, but at many points the sewer penetrates a sandy silt, difficult to pass because it is water-bearing. Despite the requirements for lining, it was found more economical to construct the sewer by tunneling rather than open-cut work, due to the considerable depth and the fact that trench excavation would have resulted in extensive damage to existing surface facilities and much interruption to street traffic.

Manholes were required about every 300 ft. and since a shaft of some type was needed to build each manhole, the contractor chose to make every other shaft sufficiently large to permit the tunnel to be driven both ways from each of these points. This spacing of the shaft eliminated the need for forced ventilation.

Pressed metal plate liner of the type frequently used in tunnels was used in the construction of most of the shafts. The pressed plates are 16x36 in. in size, $\frac{3}{16}$ in. thick and bent to the required diameter. They have a flange along each of the four edges to permit the sections to be bolted together at all vertical and horizontal joints. As excavation advanced, complete rings of the pressed plates were added below those already in place, the rough excavation being done by a clamshell bucket and the neat trimming with pneumatic spades and other hand tools.

According to the contractor's engineers, use of metal liner plates has many advantages: (1) deep shafts can usually be built of uniform cross section for their full depth (Fig. 4), which is in contrast to holes lined with timber; (2) no bracing is required for the liner plate, leaving the shaft free of obstructions from top to bottom; (3) the surrounding soil is supported at all stages of the work so construction can be suspended at any time; (4) the metal liner is fireproof; (5) inflow of water is controlled as easily as with timber sheathing, and (6) cost of lining a deep shaft with metal plate frequently is lower than when timber is used.

Fig. 1. Excavation and loading within the tunnel was done with hand tools. Five-segment timber lining was used in stable ground, but at many points steel plate was installed.

Under usual conditions the metal-lined shafts were constructed rapidly, as illustrated by the following: A 10-ft. dia. shaft 55 ft. deep was excavated and lined in 40 working hours, another hole of the same diameter 40 ft. deep was built in 32 hours, and a 15-ft. dia. shaft 35 ft. deep was constructed in 35 hours.

Timber used in some shafts

An ingenious combination of wood and metal liner plates solved a difficult water problem in putting down a 14-ft. dia. shaft. After 20 ft. of progress in two days, trouble developed from a large inflow of water. A continuous ring of 2-in. thick vertical wood sheathing about 10 ft. long was driven inside the metal liner already in place. Reducing the number of panels of metal lining by one, which decreased the diameter of the shaft by 1 ft., made it possible to resume the use of the metal lining and avoid installation of cross timbers. This method could be used as it was general practice to build the shaft enough larger than the desired finished diameter to allow for contingencies.

Square and rectangular shafts with timber lining also were rapidly constructed. In one case a shaft 32 ft. deep and 12x17 ft. in cross section was constructed in 40 hours. Another illustration was a 10x10-ft. shaft 35 ft. deep built in 35 hours. The lining in both cases consisted of 2-in. thick vertical sheathing held in place by 10x10-in. timber wales spaced at about 5-ft. centers.

The bottom of each shaft was paved with a plain concrete slab 6 to 8 in.

thick. The slab eliminated much trouble from water and provided a convenient working platform from which the tunneling operations could be carried on.

Tunnel excavated by hand

The minimum height of tunnel to permit encasement of the smallest size sewer was about the minimum in which men could work efficiently, namely, 5 ft., and this size was used throughout the work. However, the small dimensions of the tunnel dictated that the excavation be accomplished with pneumatic spades and the loading done by hand (Fig. 1). Simultaneously with the excavation and lining work a gravel-packed 6-in. dia. tile drain was constructed in the bottom of the tunnel to aid in controlling water.

Excavated material was removed from the headings with light-weight cars shuttled back and forth by hand on an 18-in. gage track of 20-lb. rail assembled in 15-ft. sections. The cars were equipped with 18-cu.ft. capacity steel-plate boxes 28 in. wide, 20 in. deep and 5 ft. long. The forward end of each box was sloped outward to assure removal of its entire contents by end-dumping.

The tunneling crew at each heading used a single car, and a spare box was generally kept available on a low platform at the bottom of the shaft; the limited space in most shafts did not permit installation of a switch. After a loaded box was lifted out of the tunnel, the spare container was slid by hand onto the empty carriage and the car returned at once to the face. In this method of tunneling a three-man crew at each heading proved best. Two workmen did the excavation and installed the lining while a helper shifted the cars. Small cranes were used on the surface to hoist the muck boxes and deliver supplies to the tunnel.

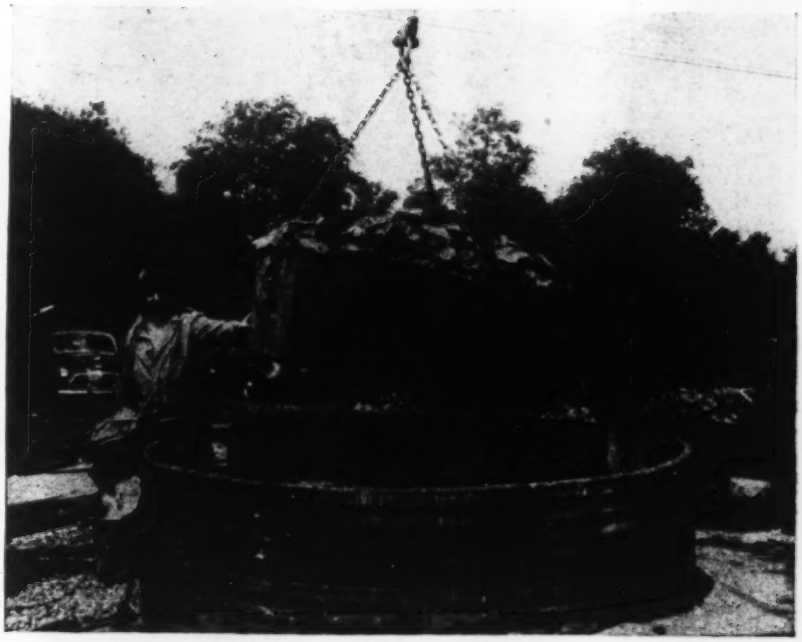


Fig. 2. The all-welded muck boxes were sloped outward at one end to expedite dumping. The boxes were lifted out of the construction shafts by crawler cranes, which were required on the job for other purposes and provided flexibility in disposal of the excavated material.

Fig. 3. Timber used for the lining work was cut to desired length with power saws at a central shop, where the three crown segments for a given section were nailed together on an assembly platform that simplified this work.

Lining of two types

The lining operation followed closely behind the excavation, utilizing 2-in. thick timber in relatively good soil and metal plates in unstable material. Normally, the timber was installed as conventional continuous five-segment lining of horseshoe-shape (Fig. 1). The five-segment design followed closely the outline of the finished sewer, resulting in less excavation outside of the "pay line," and was more economical than cap and leg lining. Timber was pre-cut with power saws at a central carpenter shop, where the top three segments for a given section were preassembled.

Installation of timber lining in the tunnel was a simple operation. First a longitudinal foot block or mud sill was put down on each side, a 2x10-in. timber generally being used. Next, vertical side pieces were added and the three-segment crown inserted. Finally, a longitudinal 2x4 was installed at each side at the base of the lining and crossbraces inserted between these two timbers. In good ground 2x4-in. crossbraces on about 5-ft. centers were sufficient, but in poor soil they were closer together, in some cases being practically a solid floor.

Metal liner installed also was in the shape of a horseshoe, with some straight plates at the side. With this lining it was possible to penetrate rather wet material without resorting to compressed air. However, where heavy flows of water were encountered, the contractor immediately put sections under "air" rather than gambling on

passing the bad spot without the added expense.

Air was supplied by a 750-cfm. low-pressure compressor powered by a diesel engine and delivering to a steel equalizer tank 4 ft. in diameter and 8 ft. high. The locks were of the conventional type. At the points where they were installed extensive grouting was done outside the tunnel lining to safeguard against blowouts. Another safety precaution was the use of minimum practicable pressure inside the tunnel, 9 to 10 psi. being the maximum.

Fig. 4. Although the contractor was the first builder in the Baltimore area to employ metal plate to line shafts required on sewer work, this procedure saved time and provided a uniform-diameter hole free of bracing. The canvas near the bottom of the shaft prevented incoming water from spouting outward and resulted in more pleasant working conditions.

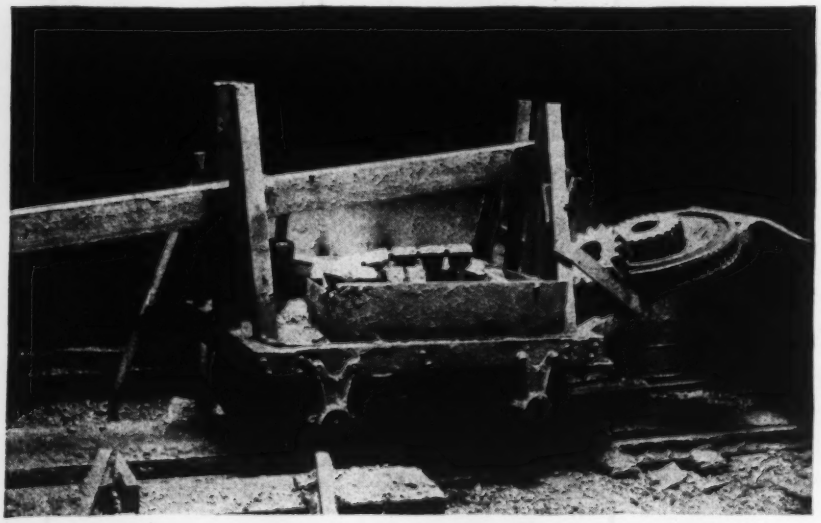


Fig. 5. Within the tunnel the sections of vitrified pipe were trasnported with this car. The beam projecting at the left rests on a hydraulic jack near the midpoint, which permitted a single section of the pipe to be raised by extending the jack.

As soon as the tunnel was completed between two shafts, this section of the sewer was constructed. Where 27-in. dia. vitrified pipe was used, the 3-ft. sections, which weighed about 900 lb. each, were transported within the tunnel on a special car equipped with a beam cantilevering outward in front of the carriage (Fig. 5). The pipe was lowered from the surface and picked up on the beam, which was raised by a hydraulic jack at the front of the carriage. The car was rolled to the desired location in the tunnel and the jack released to lower the pipe into place on 6x8-in. timbers, which permitted the pipe to be completely encased with concrete. A 5-man crew below ground was able to install as much as 25 sections of the pipe in an 8-hr. day.

Normal practice was for two workmen to handle the hauling car and three men to set the pipe and caulk the joints with jute and cement mortar. These men also installed bracing above the line to keep the pipe from floating upward while being encased with concrete. A side clearance of 6 in. (outside the bell) and 4 in. top and bottom was maintained around the pipe.

Concrete dropped down 6-in. pipes

Specifications required that the entire space outside the pipe be filled with concrete having a compressive strength of 2,000 psi. at 28 days. A most successful and unusual plan of dropping the concrete down 6-in. dia. steel pipes, installed at 50-ft. intervals along the center line of the sewer, was used (Fig. 6). To aid ventilation inside the tunnel, these pipes were installed ahead of the excavation, the pipes being threaded at the top to permit the addition of caps where construction under air was necessary.

Concrete was purchased from a commercial central mixing plant and delivered in agitator trucks. The mix used for encasement had five sacks of cement per cubic yard of concrete with a maximum of 8.87 gal. of water per sack, giving a slump of about 6 in. At the construction site, 1½ lb. of a cement-dispersing admixture was added for each bag of cement and the concrete agitated for five minutes after the admixture was added. The resulting concrete flowed readily and was placed without segregation.

Normal placing procedure was to close off a section of the sewer with

bulkheads and deliver concrete first at the 6-in. pipe nearest the last concrete placed, then advance one pipe at a time. Difficulty from concrete clogging in the delivery pipes was quickly overcome by use of an air jet at the end of 30 ft. of 1-in. dia. pipe. As much as 200 ft. of the vitrified pipe sewer was encased in about four hours in a continuous pour requiring 90 to 100 cu. yd. of concrete. By exercising care in the placing work, voids in the top of the tunnel were eliminated without puddling or use of vibrators.

Cast-in-place sewer

Concrete for the cast-in-place sections of the sewer also was dropped down 6-in. dia. pipe installed at 50-ft. intervals. The lower half of the sewer was built first, utilizing the same concrete mix, including the cement-dispersing admixture that was employed for encasing the vitrified pipe.

The invert forms consisted of 5-ft. long semi-circular sections of $\frac{1}{8}$-in. thick metal plate. Each section was equipped with a single spreader bar with a built-in turnbuckle that permitted the diameter of the form to be reduced after the concrete hardened, thereby expediting removal. As soon as the invert form had been removed, a $\frac{1}{2}$-in. thickness of 1:2 sand-cement mortar was applied and $\frac{3}{4}$-in. thick standard vitrified clay tile liner plate put down for the full 180 deg.

Arch forms were similar to those used for the invert, but were made in 10-ft. sections, each equipped with two spreader bars. In constructing the arch the entire space above the forms was filled with concrete having a minimum compressive strength of 3,000 psi. at 28 days. Six bags of ordinary portland cement, with $1\frac{1}{2}$ lb. of cement-dispersing admixture and a maximum of 7.70 gal. of water per sack was used for the arch form.

The $360,000 project was carried out by the Baltimore Bureau of Sewers. For the city, Nathan L. Smith is chief engineer, George E. Finck is head of the bureau, and John Moore is bureau construction engineer. W. Franklyn Garrett was resident engineer.

Square Construction Co., Cleveland, Ohio, was the general contractor. For this firm, Frank P. Ragonese, president, was in general charge, while Joseph Fisher and Camelli Campenella were in direct charge in the field.

Fig. 6. The concrete required in the tunnel was dropped down 6-in. dia. pipes installed at 50-ft. intervals along the sewer. A jet supplied with air by the compressor in the background eliminated clogging in the delivery pipes.

Meters Help Traffic Conditions By Reducing Parking Time

Use of parking meters has decreased the average parking time of cars on city streets, according to a report of the Municipal Finance Officers' Association.

A survey in Johnstown, Pa., showed the average parking time was reduced from 52 min. to 32 min. following the installation of meters. Pittsburgh noted a reduction in parking time from 26 to 19 min. and a similar survey in Washington, D. C., showed that the average time of parking dropped from 46 to 40 min.

With this reduction in parking time, cities observed that more cars had an opportunity to park on city streets and also that the number of vehicles cruising the street in search of a parking place had been cut. One indication of the more rapid movement of traffic was reported from Toledo, O., where bus service speeded up 9 percent following the installation of parking meters in the business districts.

Opinion in the 473 cities now using parking meters is almost unanimous that meters aid materially in the enforcement of parking regulations. It is now possible for motorized patrols to check on compliance with parking regulations without stopping at each vehicle. Of equal importance is the fact that there can be no dispute between the motorist and the officer regarding the time actually parked.

Commenting on the revenue-producing abilities of parking meters, the Municipal Finance Officers' Association cites the annual income from this source of 323 municipalities which in 1944 averaged $62.38 per meter. This average includes meters in operation only part of the year.

One problem arising from the use of parking meters has been that of parking commercial vehicles while loading and unloading. Many cities are reported to allow trucks to load or unload on metered space without charge up to a specified time in the morning. Where the problem has been continuous throughout the day unmetered loading zones may be provided.

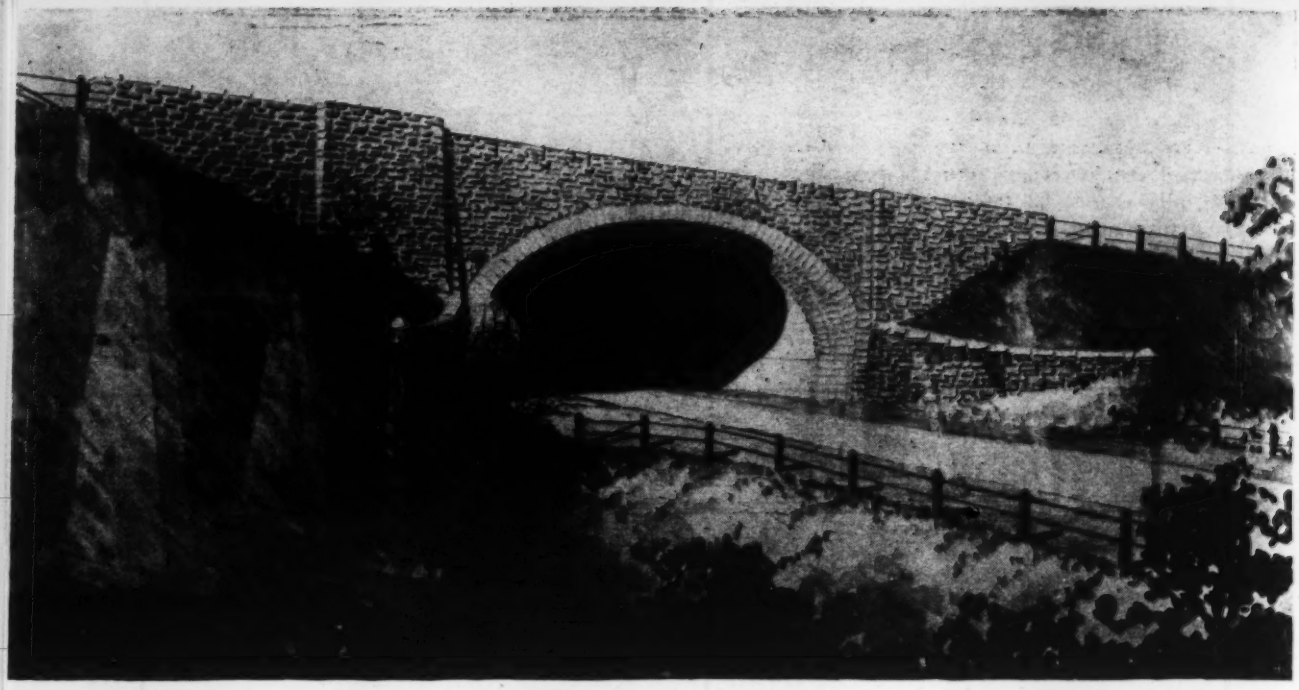


Fig. 1. Wingwalls of the arch bridge over Fountain St. are carried on columns, as indicated in phantom form at the left.

Design of Wilbur Cross Parkway Bridges

John F. Willis
Engineer of Bridge Design
State Highway Dept., Hartford, Conn.

Contents in Brief *— Proposed for the Wilbur Cross Parkway — Connecticut's superhighway for speeding traffic between New York City and Boston — are several noteworthy grade-elimination structures. Fountain St. Bridge is a skewed reinforced-concrete arch with wingwalls supported on columns; the crossing over Route 69 is carried on a two-span welded, continuous girder, each span of which is 125 ft., and Dixwell Ave. Bridge is an all-welded 126-ft. deck plate-girder span designed for composite action with the concrete slab. Major considerations affecting the design of these and other structures are outlined.*

CROSSING CONNECTICUT on a diagonal, from the New York State line at the southwest corner to the Massachusetts line at the northeast (Fig. 2), a superhighway is being constructed for through traffic between New York, New Haven, Hartford and Boston. In the vicinity of New Haven, on a section called Wilbur Cross Parkway, grade crossings will be eliminated through the use of several interesting bridges. These include reinforced concrete frames and arches, welded continuous girders, and structures designed for composite action between the concrete roadway slab and the steel members.

In selecting the type of bridge to be used, many factors, varying with each location, had to be taken into consideration. Among them are grade, alignment and clearance requirements of the intersecting roads, topography, foundation conditions and scenery. However, before the effect of these factors on design are discussed, it might be well to examine the nature of the proposed superhighway.

Highway divided into sections

The western end of the parkway, an extension of the Hutchinson River Parkway in New York State, has been completed to a highway intersection west of New Haven (Fig. 2). The section from the New York line to the Housatonic River is known as the Merritt Parkway (*ENR* July 20, 1939, vol. p. 70).

Between the Housatonic River and the Connecticut River is the Wilbur Cross Parkway (*ENR* Nov. 6, 1941, vol. p. 640), a dual-lane limited access road, traffic on which is restricted to pleasure vehicles. The remaining section, known as the Wilbur Cross Highway, is identical in construction but has no traffic or access restrictions. Completed portions of these sections are indicated in Fig. 2 by solid lines.

In cross section, the Wilbur Cross Parkway differs but little from the Merritt Parkway. Total width of each lane from the edge of the center mall to the guard railing, which includes the paved shoulder, is in most cases 35 ft., with widening where necessary for ingress and egress. The central mall varies from 10 ft. to the 30 ft. required at the entrance to the tunnel north of New Haven. Loading to be carried is H20-S16.

With regard to grade separation structures, a somewhat different design policy from that used on the Merritt Parkway now prevails. On that

highway, many of the overpassing structures are single-span rigid frames of concrete, where span length permits. While this type of structure is economical and well adapted to grade separations, overuse may be monotonous.

Because single-span bridges do not allow as much freedom in architectural treatment as do multiple spans, all structures over the Wilbur Cross Parkway are designed as two-span continuous bridges where foundation conditions permit. If boring data indicate existence of dubious foundation conditions, either simple spans or individual structures are specified.

Steel will be used to a much greater extent on the Wilbur Cross Parkway than on the Merritt Parkway. In some cases, length of span makes concrete uneconomical, but in a number of the shorter span structures, particularly where uncertain foundation conditions exist, rolled-beam superstructures will be used with no sacrifice of pleasing appearance. Also, since a complete "face lifting" may easily be obtained by sandblasting and repainting steel with little doubt of the results, ease and economy of maintenance favor steel construction.

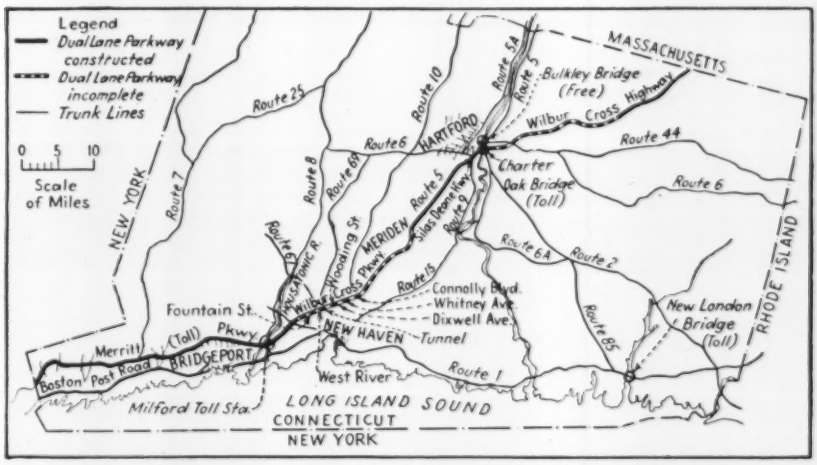


Fig. 2. Connecticut's express highway, which when completed will cut diagonally across the state, is divided into three sections, Merritt Parkway, Wilbur Cross Parkway and Wilbur Cross Highway. The two parkways are limited access routes on which no trucks are allowed.

Grade of Fountain St. a problem

The treatment of several road intersections in the vicinity of New Haven, where extraordinary topographic conditions at the site have imposed difficult conditions, is worthy of note. Foremost among these crossings is the bridge carrying the parkway on a 6 percent grade over Fountain St., which at the intersection has a grade of about 10 percent and is on a moderately high fill.

On either side of Fountain St., the terrain rises to a height of sufficient extent to justify a parkway overpass. Had Fountain St. been carried over the parkway, a cut of several hundred thousand cubic yards might have been necessary. Comparative designs favored the structure selected, even though a bridge over the parkway would have been considerably simpler in design and consequently less expensive, and a large portion of the excavated material, predominantly rock and boulders, could have been used advantageously elsewhere.

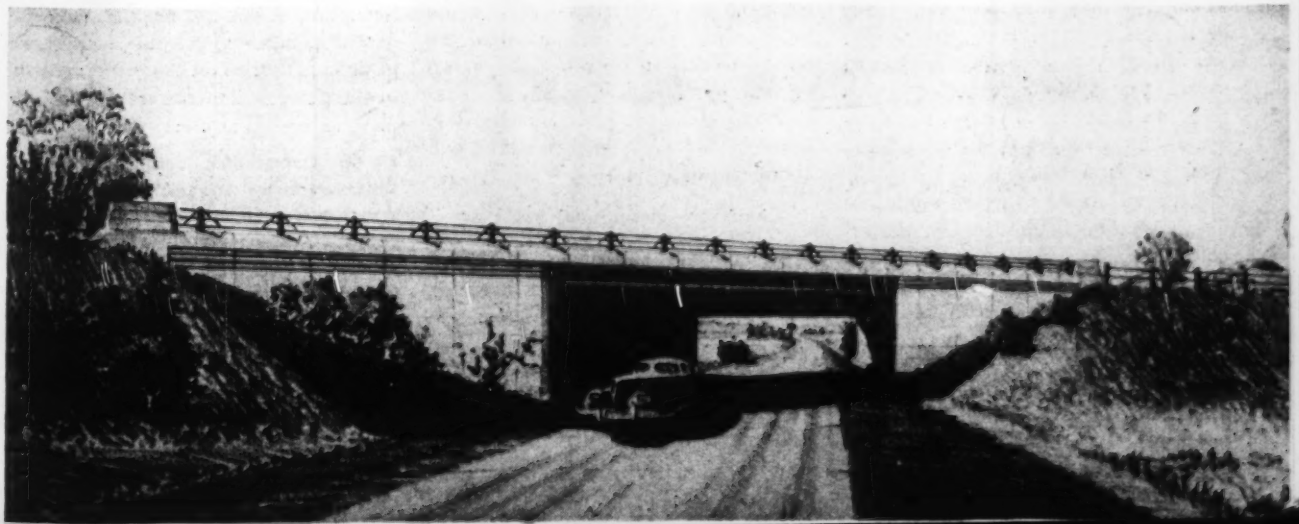
Several features in the design of this structure are outstandingly different from any other on this or the Merritt Parkway. The bridge is a single span, reinforced concrete arch, skewed at an angle of about 15 deg. 40 min. Because of the 10 percent grade on Fountain St. and the usual necessity of holding down the grade of the overpassing road, the frame was designed as three separate longitudinal sections. In each of the sections, the skewed distance between faces of abutments is 60 ft., but the rise relative to the height of leg varies to conform to the street grade.

Designed for H20-S16 loading, the arch rib varies in thickness from 2 ft. at the crown to 3 ft. $1\frac{3}{8}$ in. at the springing line. From this last section the legs are widened on the roadway side on a slope of $\frac{3}{4}$ in. in 12 in. for a distance varying from 7 ft. 6 in. to 10 ft. and then are brought sharply back to the springing line width. Since the parkway has a 6 percent grade at the intersection, the height of spandrel walls is different at each abutment of the bridge.

Columns carry wingwalls

The east wingwalls, which are on the side of the high embankment, are supported on columns between which the fill is permitted to pass. Near the toe of the slope, the embankment is retained by a low wall (Fig. 1 and 5). This type of construction should afford an appreciable saving of materials and reduce costs.

Fig. 3. This structure over Route 67, typical of many others used under similar geographic conditions, consists of rolled steel beams designed for composite action with roadway slab. Abutments faced with precast slabs of artificial stone.



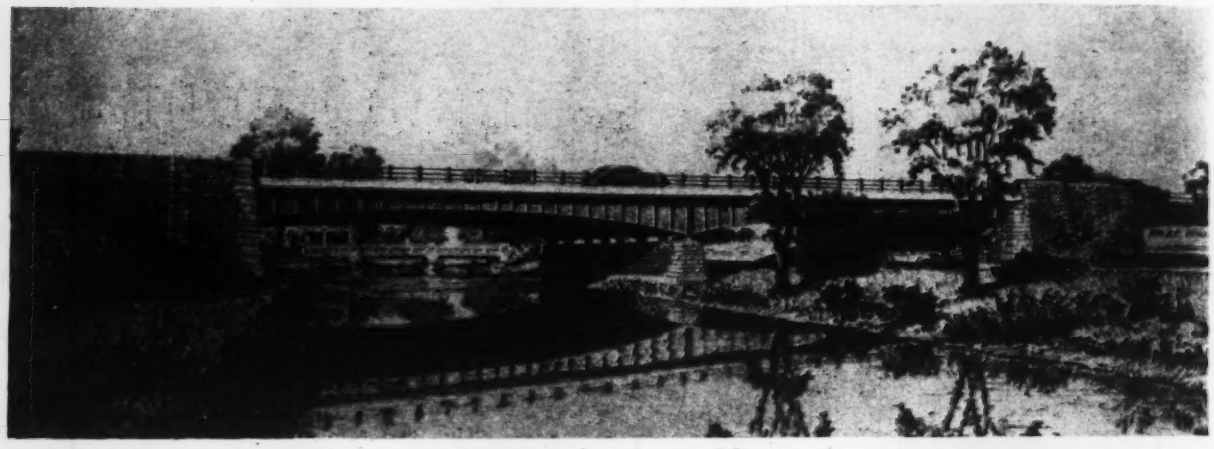


Fig. 4. Welded continuous girders carry the parkway over West River and Route 69. Details are shown in Fig. 5.

The exposed surface of the Fountain St. bridge will be faced with random ashlar, except that granite dimension stone will be used for the arch rings and wherever a sharp outline is desirable. (It should be noted that the specification of the Connecticut State Highway Department for random ashlar masonry facing does not require all stones to be square or rectangular but "shall simulate the appearance and conform to the dimensions shown on the plans.") Because of the picturesque setting, the expenditure for natural stone facing, which will be no small part of the total cost, is considered well justified.

Rolled beams used for some bridges

Near Fountain St. in the broad, level flood plain of the West River, Wilbur Cross Parkway is carried over Route 67. Foundation conditions at this site are such that light settlement could occur, a condition that usually precludes the use of frames and arches.

The type of bridge selected is typical of many others used under similar geographical conditions. The superstructure consists of rolled, wide-flange I-beams, with special provision made to tie the concrete floor slab to the top flanges to develop horizontal shear. Composite construction of this type has proved advantageous where headroom is tight. It reduces deflections and is economical.

Since an ornate structure would not be appropriate in this region, the architectural treatment is simple and intended to be in harmony with the surrounding country. Exposed portions of wingwalls, abutment faces and parapets are overlaid with precast concrete slabs of artificial stone. This precast slab facing was used on the Merritt Parkway with entirely satisfactory results, both esthetically and economically, and has the advantage that the large slabs, 12 to 20 sq. ft. in area, replace formwork and eliminate the necessity of finishing the surfaces.

While a wide variety of colors and patterns are available, only cast stone simulating gray and pink granite and brown, white or red sandstone will, in general, be used for bridge ornamentation. However, in a few cases a micaceous element will be added to produce a scintillating effect under headlights or the direct rays of the sun. Although this sparkling stone has a pleasing appearance at first, it is somewhat susceptible to dust and loses most of its brilliance after a few years. To restore the original texture, it may be necessary to resort to washing under pressure or air blasting.

Surprisingly, a different type of facing is specified for a structure carrying the parkway over Route 69 and West River only about 1,000 ft. easterly from the Route 67 bridge and in the same valley. In consideration of the river crossing and because the site is on the approach to West Rock Mountain and a tunnel, granite facing was specified for the pier, wingwalls and abutments (Fig. 4).

Continuous girder over Route 69

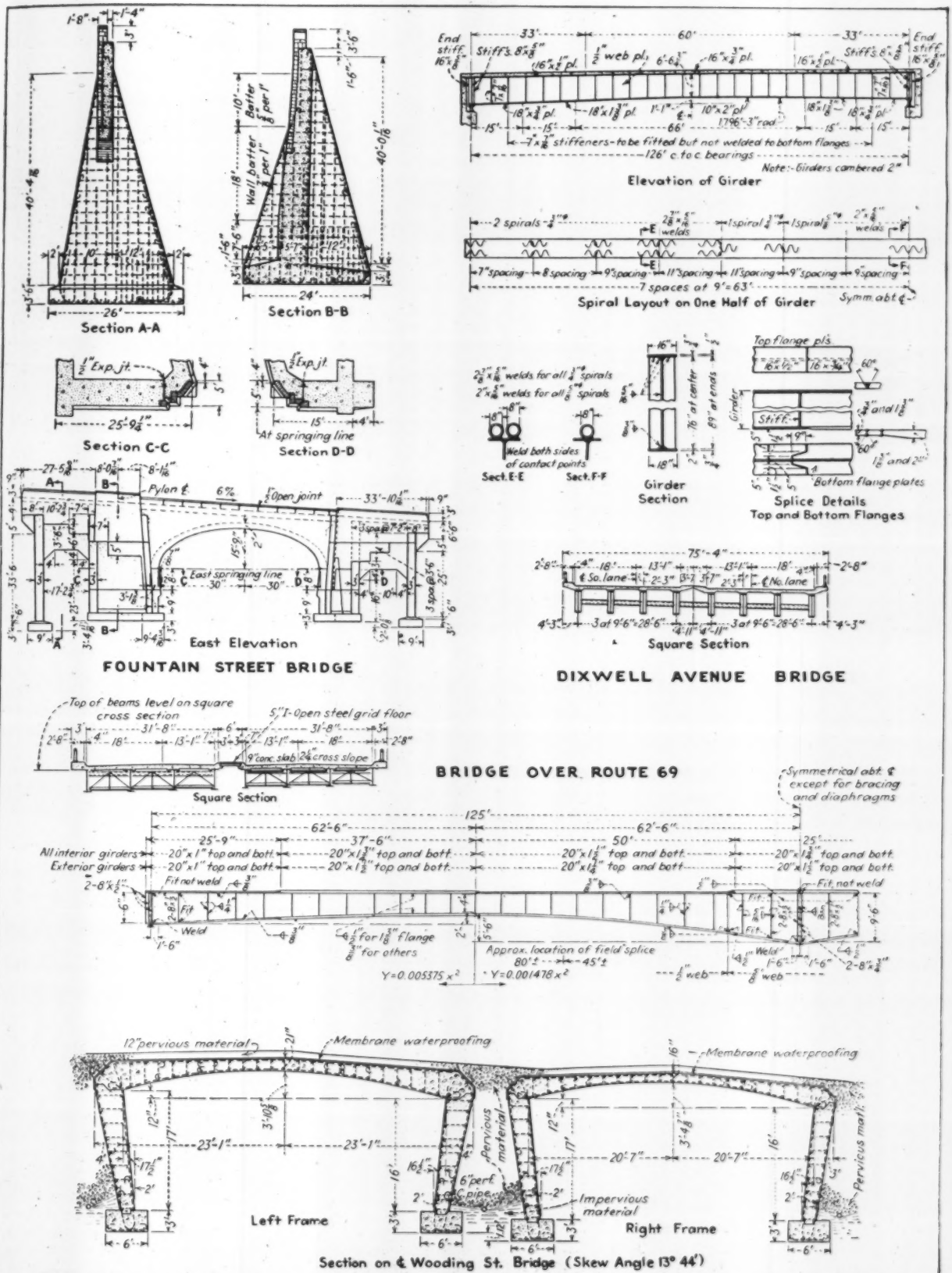
At this site the parkway will be carried over Route 69 and West River on eight two-span welded continuous girders with variable depth of section (Fig. 5). Each span is 125 ft. between bearings.

Symmetrical about the center support, the girders are 4 ft. deep at the center of each span, 6 ft. at the free ends and 9 ft. 6 in. at the center bearing, measured between inner faces of flanges. The web is $\frac{1}{2}$ in. thick, except for a length of about 28 ft. over the middle support where a $\frac{5}{8}$-in. plate is used. Top and bottom flange plates are 20 in. wide and vary in thickness from 1 to $1\frac{3}{4}$ in., as indicated in Fig. 5. The parabolic lower flange rises 2 ft. at midspan relative to the free end and 5 ft. 6 in. relative to the intermediate support.

Before this design was finally decided upon, two separate, detached structures were considered. However, it was found that these would increase the cost by over 40 percent. Another disadvantage of individual bridges is that a bad traffic hazard—a blind intersection—would incidentally be created where a local road enters Route 69 close to the proposed crossing.

Furthermore, genuine advantages accrue from the adoption of the continuous type, particularly at this site. Reduction of positive bending moment due to continuity permits a decrease in depth of girder at the center, which in turn allows increased headroom.

Fig. 5. Outstanding details of Wilbur Cross Parkway bridges, shown in the drawings on the opposite page, include design of columns to support wingwalls, welding of continuous girder, proportioning of unsymmetrical skewed two-span rigid frame and design of a long-span welded girder for composite action.


Section A-A
Section B-B
Elevation of Girder
Spiral Layout on One Half of Girder
Section C-C
Section D-D
Girder Section
Splice Details
Top and Bottom Flanges
East Elevation
FOUNTAIN STREET BRIDGE
Square Section
DIXWELL AVENUE BRIDGE
Square Section
BRIDGE OVER ROUTE 69
Left Frame
Right Frame
Section on ℄ Wooding St. Bridge (Skew Angle 13° 44')

This is important because in order to maintain the necessary 14-ft. vertical clearance, it would otherwise have been necessary to raise the grade for a considerable distance in both directions at the expense of a greatly increased borrow item and also higher and costlier wingwalls.

The east abutment, east wingwalls and center pier will be supported on 30-ft. steel piles driven to rock. Unless unforeseen foundation conditions should be uncovered, the probabilities are that piles will not be required for the west abutment and wings.

From the architect's viewpoint there seems to be little, if any, argument against welded structures with smooth, flowing lines easily assimilated by the eye, as compared to the ugly, mechanical appearance of riveted girders. In addition, riveted construction in this case was found to be more expensive by over 11 percent, using estimated prices of 7c. per lb. for welded against 6c. for riveted steel in place complete. Weight of the welded steel was estimated at 780,000 lb., while the same superstructure assembled by riveting would weigh about 1,028,300 lb. Thus:

1,028,300 lb. at 6c. = $61,698 riveted
780,000 lb. at 7c. = 54,600 welded

$7,098 saved

Estimated cost of the bridge is about $200,000 or $11.27 per sq. ft. of projected floor area, based on the average level of prewar unit price bids. What actual bid prices will be is still a highly debatable question.

Design of unsymmetrical frames

Another two-span overpass of interest is the rigid-frame structure carrying Wooding Street, Hamden, over the parkway on a skew of 13 deg. 44 min. (Fig. 6). The setting is rustic, and an architectural problem was posed by the 10 percent grade of Wooding Street, which precluded symmetry, especially with regard to the spandrel walls. A satisfactory solution seems to have been attained (Fig. 5) by lengthening the span on the high side by 5 ft. and lowering the rib of each span on the side of the descending grade 1 ft. relative to the opposite side.

Although a two-span structure, this bridge is not of the continuous type. Rather the two frames are independent, and expansion joints are provided to take care of unequal settlement.

The skew span at springing line of the frame on the high side is 46 ft. 2 in. At the crown the thickness of rib is 1 ft. 9 in., increasing to 4 ft. at springing, and the legs taper to a width of 2 ft. at top of footing. Spanning 41 ft. 2 in., the other frame is 1 ft. 4 in. thick at the crown and 3 ft. at springing. While the footings of each frame are on the same level, those on the longer-span side are 1.12 ft. higher.

Long-span welded girders

Farther east, the parkway is carried over two main arteries, Whitney and Dixwell avenues, by deck plate-girder structures differing from each other only in detail. Broad streets crossed on a skew required span lengths somewhat in excess of those encountered elsewhere on this project.

A satisfactory solution to the long-span problem in both cases would be conversion of both avenues into dual highways for some distance from the bridges, construction of a pier in the separating mall and substitution of a two-span structure. This plan is a good safety measure and sound engineering, but the total cost would exceed that of the design selected.

The longer crossing of the two is the 126-ft. one over Dixwell Ave., spanned by all-welded deck plate girders, designed as composite beams and having curved lower flanges (Fig. 5). Over Whitney Ave. is a similar structure, excepting that the span is 118 ft. 6 in. and the top and bottom flange plates are parallel. In both cases headroom was limited and a shallow superstructure highly desirable in order to maintain the required 14-ft. vertical clearance.

The girders over Dixwell Ave. have a ½-in. thick web and vary in depth from 6 ft. 6¾ in. at the center to 7 ft. 6¼ in. at the ends. Top flange plates are 16 in. wide, from ½ to ¾ in. thick, and bottom plates 18 in. wide, from ¾ to 2 in. thick, as shown in Fig. 5. The lighter top flange is due to participation of roadway slab in carrying compression stresses. To insure composite action between the concrete slab and the girders, patented spiral shear connectors are welded to the top flanges.

Welding was specified for the fabrication of these girders because of economic and architectural advantages over riveting, based on experience with ten all-welded bridges now in service in Connecticut. A systematic inspection of these structures, conducted over a period of from one to five years after their completion, revealed that no defects in welding had developed, nor was any permanent distortion visible.

Viaduct spans road and railway

East of these girder bridges is a relatively more complicated intersection. The Northampton Division of the New York, New Haven & Hart-

Fig. 6. The Wooding St. crossing posed a problem in architectural treatment because of the steep grade of the overhead road.

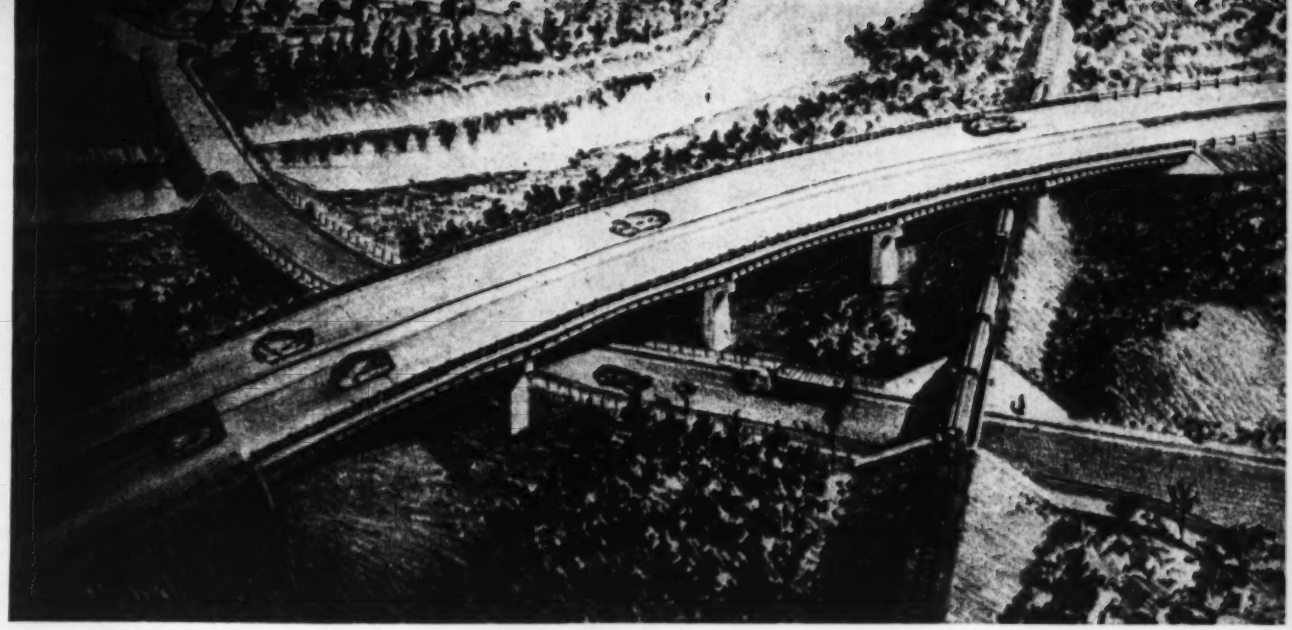


Fig. 7. Parkway is carried over Connolly Blvd. and railroad on 5-span deck plate-girder viaduct on a 4-deg. horizontal curve and 600-ft. vertical curve. About 570 ft. long, the structure carries two lanes of 31-ft. width and is supported on concrete bents, chosen instead of steel for the sake of appearance.

ford Railroad is carried over Connolly Boulevard, and the parkway passes over both, (Fig. 7). A 5-span deck plate-girder viaduct, measuring 570.15 ft. along the center line, is specified. The span at the west end bridges the railroad and the east end spans Connolly Boulevard.

Alignment of the highway imposes a few annoying details. The viaduct is on a 4-deg. horizontal curve, and each 31-ft. 1-in. wide traffic lane is banked 23.31 in., or $\frac{3}{4}$ in. per foot, while the center mall is horizontal radially. Furthermore, the structure is on a 600-ft. vertical curve with tangent grades of +0.95 and −3.49 percent.

Piers designed as concrete bents

The horizontal curvature, grade and superelevation leaves little leeway in architectural treatment of the superstructure. However, it was recognized that due attention must be given to the appearance of the piers. Several attempts were made to design steel columns on concrete bases, but while requirements of safety and economy were satisfied, those of appearance were not. Finally, concrete column bents were decided upon. The cost will be but slightly more than that of the steel columns considered, while the results in appearance will be far more gratifying.

As for the cost of this viaduct and other bridges on the Wilbur Cross Parkway and Wilbur Cross Highway, there may be a wide differential between the actual costs and the estimated, because of the huge total quantities, coupled with the great uncertainties relative to unit bid prices when normal construction is resumed. On the basis of 1940 and 1941 bids, the estimated cost of the parkway, exclusive of the tunnel, is about $10,000,000, of which nearly $3,000,000 will be expended for bridges of all types, including the necessary approach work, clover-leaves and other connections.

Proposed financing

The project will be financed by tolls collected at toll stations on the Merritt Parkway and by 5 percent of the gross highway fund set aside for that purpose. If sufficient money is not thus obtained, a bond issue not to exceed $4,000,000 is authorized by the general assembly.

Owing to the magnitude of the work, it is likely that the parkway and tunnel will not be completed and opened to traffic until at least the fifth postwar year. Since many other projects in Connecticut may be under contract concurrently with this one and since nearby states have an extensive postwar program that will fully engage their contractors, even if the entire sum necessary for construction were available, there is not a sufficient number of qualified contractors in or near Connecticut to do the work in a shorter time.

The renderings of the grade-elimination structures were executed by George L. Dunkelberger, highway architect. In preparing the designs of the bridges, details shown on the renderings were incorporated into the working plans. This procedure was followed on the Merritt Parkway project, and the photographs of the completed structures reveal a startlingly close resemblance to the pre-construction renderings.

Ceiling Construction Rated on Fire Protection

In connection with a project sponsored by the National Housing Agency, the National Bureau of Standards made fire tests on typical ceiling constructions and compiled data from other tests that had been made of ceilings exposed as part of floor constructions. According to *Technical News Bulletin*, Feb., 1946, published by the bureau, the following conclusions were reached:

"The ceilings were found to give protection to supporting members and to prevent communication of fire for periods ranging from 8 min. for wood lath and lime plaster to 60 min. for a metal lath and plaster ceiling supported on steel joists. Protection in the range 11 to 16 min. was given by gypsum boards or sanded gypsum plaster on gypsum or metal lath attached directly to wood joists. The protection was considerably increased by mineral wool insulation placed over metal lath and plaster ceilings suspended below wood joists."

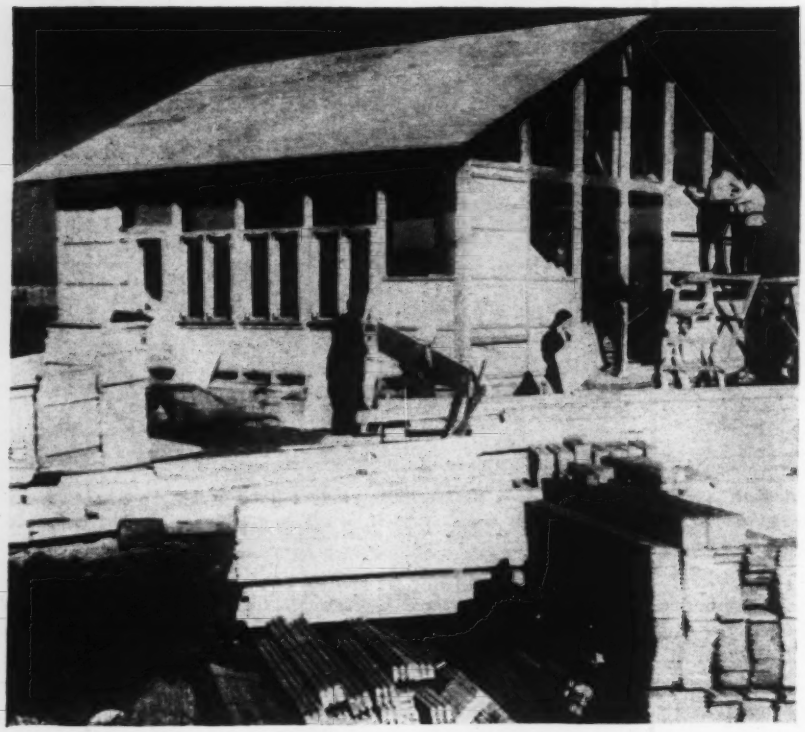


Fig. 1. Prefabricated house in an automobile workers settlement of Dniepropetrovsk assembled in a few days. At this site 72 one-family houses were built.

Soviet Union Develops New Building Techniques

***Contents in Brief**—Organized for construction on an enormous scale, the government of the Soviet Union plans, finances and builds all structures, trains all personnel and sponsors research. This last activity has developed, among other things, a new theory for designing reinforced concrete, winter concreting techniques and earthquake-resistant brick arch roofs. To expedite design and erection, prefabrication and standard designs are used to a large extent.*

DEVELOPMENT of a modern, widespread construction industry with a huge army of highly trained workers and an efficient supervisory and management organization is an immediate goal of the Soviet Union to make its tremendous building program possible. Work must be completed in the shortest possible time with the least amount of materials.

The answer to the materials problem is looked for in carefully worked out standard designs and specifications and in technological developments. Through research on a large scale, new desig s and methods of construction have been adopted to expedite construction and conserve materials.

The government plans and finances all building, provides for the education and training of personnel, and sponsors research, standardization and prefabrication, which it believes will make construction on a large scale feasible. All building is performed and supervised by government agencies.

The main organization for dealing with industrial construction is the People's Commissariat for Construction, which coordinates the activities of several subdivisions. These are: (1) administrative departments, each of which is responsible for work in an assigned region; (2) specialized construction departments, for steel fabrication and erection, electrical work, and plumbing, heating and ventilation; and (3) technical departments, concerned with specifications, design and material supply. In dealing with major problems, the commissariat is advised by a technical council composed of experienced engineers and scientists.

The regional administrative departments are divided into trusts, each of which operates in a given district as a general contractor. On the other hand, the specialized departments have their own trusts that perform as subcontractors.

The trusts that act as general contractors have, as a rule, a number of field offices, each responsible for a definite project. The work is supervised by a general superintendent, a chief engineer, superintendents and foremen for separate sections of the project. A foreman is in charge of several crews of workers, each of which is headed by a highly skilled worker known as the "brigadier."

In the main construction trades, workers are paid on a piece-rate basis, with incentive given for greater output by payment at a higher rate for work performed above an established norm. In addition, high honors are bestowed upon those who achieve outstanding results.

Materials are not generally the responsibility of the construction commissariat. While most of the construction trusts establish their own sand and gravel facilities, concrete block plants and wood-working shops, major building materials are supplied from plants belonging to the People's Commissariat for the Building Materials Industry. Testing of materials is done by field laboratories of the trusts, and in some instances by larger central laboratories.

Training of personnel

The enormous scale of construction in the Soviet Union calls for early and planned training of a great number of qualified construction personnel. Training of qualified workers is achieved through group and individual teaching of unskilled laborers, trade schools and schools attached to fac-

tories and plants, and "Stakhanov" schools. The purpose of the last type is to teach the worker to improve his output by using machines and special tools, eliminating unnecessary operations, carefully preparing the place of work, coordination of different phases of the job and mastering of production processes.

In addition, there are schools for foremen and places for instruction known as technicums—a trade high school whose function is to train young technicians in the building trades. Higher education for construction engineers and architects is provided by the building institutes, by special building and construction departments of various engineering colleges, by architectural institutes and the departments of architecture within other colleges, and by the Academy of Sciences.

While worker-training is an important phase of the building program, its success hinges to a great extent on the results of research, which is carried out on a large scale by research institutes of the People's Commissariat of Construction: the Central Research Institute of Industrial Structures, the Institute of Construction Organization, and the Institute of Water Supply, Sewerage and Hydro-geology. In addition, research work is performed by the Soviet Union Academy of Architecture and by engineering and architectural colleges.

In the field of building materials, there are the institutes of cement, ceramics, glass and gypsum, and the Institute of Building Materials in Kharkov, Ukraine and elsewhere. Furthermore, research is performed by a chain of central trust and plant laboratories, as well as by many small laboratories at the jobs.

New design theory for concrete

Some of the more significant results of this research are to be found in connection with the design and construction of concrete structures. For example, as a result of experiments performed in Moscow about 1930, a new theory for designing reinforced concrete was developed. Previously, design had been based on commonly accepted formulas involving the ratio of the modulus of elasticity of steel to that of concrete. The new theory abandons the modular ratio and bases design on ability of structural members to carry load up to failure. It was adopted by

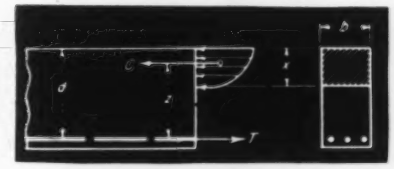


Fig. 2. Bending stresses in reinforced concrete are computed in the Soviet Union by formulas based on a parabolic stress distribution.

the Soviet Union about ten years ago because it is believed to yield more accurate and economical results.

According to the new theory, the load P' that can be carried by a short column at destruction is given by

$$P' = A_c f_{cot} + A_s f_{sy},$$

where A_c is the area of concrete, A_s the area of steel, f_{cot} the ultimate stress of the concrete ($0.8f'_c$), and f_{sy} the yield point stress of the steel. The allowable load P is obtained by dividing P' by a factor that varies from 1.8 to 2.2, depending upon the ratio of live to dead load. This formula is said to call for about 10 percent less steel than American formulas. For long columns, P is multiplied by a reduction factor that varies from 1 for $L/d \leq 14$ to 0.5 for L/d about 30.

In bending, the theory assumes that the concrete takes no tension and that the stress diagram in the compression area is a cubic parabola (Fig. 2). The total compressive force at failure then is:

$$C = f_{cb} x b k,$$

where x is the depth of the compression area, b is the width of section and k, a function of the shape of the stress diagram that would be 0.5 for a triangle and 1 for a rectangle, is taken as 0.8. In this case f_{cb} is found to have a value somewhere between f_{cot} and f'_c.

The tension force $T = A_s f_{sy}$. Since $T = C$,

$$f_{cb} x b k = A_s f_{sy}$$

If, for convenience, α is substituted for kx/d, then

$$\alpha = \frac{A_s f_{sy}}{f_{cb} b d}$$

and is called the characteristic of the section.

When moments taken about the steel are equated to the external moment at failure M',

$$Cz = M'$$

with z having a value close to $d - x/2$. Actually, $0.53xd$ is used instead of $x/2$. Thus,

$$M' = (1 - 0.53\,\alpha)\,\alpha f_{cb} b d^2$$

A factor of safety varying from 1.6 to 2.0, depending upon the ratio of live to dead load, is applied to obtain the allowable moment.

For small percentages of steel, this formula is said to give about the same results as American formulas, but when the amount of reinforcing approaches 0.75 percent, U.S. formulas call for the use of compression steel, the Russians point out, whereas theirs does not require compressive reinforcement until the tensile steel percentage exceeds 2.2. Low concrete compressive strengths are specified to conserve cement.

An analogous development has taken place in arch theory, where Russian research has adapted native techniques of constructing thin, brick-vaulted roofs in seismic regions to present-day needs. "Uzbekistan" vaulting, developed by a Russian engineer, A. I. Rabinovich, utilizing double curvature and a shape precluding occurrence of tensile stresses (Fig. 3), is meeting with approval in many parts of the Soviet Union.

A typical brick vault has a span of 2 meters (6.56 ft.) and a rise of 30 cm. (11.81 in.) in the longitudinal direction and a rise of from 1/10 to 1/6 of the span in the transverse direction. The thickness of the arch shell is about 2.5 in. At the intersection of adjacent vault elements, brick arches with inverted tee section, having about a 15-in. wide flange and 10-in. deep web, are provided for convenience in erection, the support given to the roof after construction is completed being negligible. The mortar generally used is a mixture of gypsum and loess, but for long spans a mixture of lime and cement is used.

Winter concreting methods

Another important result of Russian research is the development of methods for winter concreting. Three techniques are used:

The Thermos Method—Placing hot concrete into forms covered with insulation is the most economical procedure, but for thin members or during severe cold spells either of the other two methods are preferred. Usually high-type cements are used, sometimes with the addition of calcium chloride. A formula has been developed to calculate the rapidity of cool-

ing so that the engineer can determine how long it will take for concrete to harden when it is in a warm condition.

Steam Curing—For steam curing, employing double forms, or special types of perforated forms or sometimes pipes embedded in the concrete, temperatures of 50 to 80 deg. C. are used.

Electrical Curing—The principle on which electrical curing is based is that wet green concrete is to some extent electro-conductive, the resistance being sufficient to raise the temperature considerably. The added heat may be useful in accelerating setting and hardening of the concrete or in preventing it from freezing at too early a stage Since direct current decomposes the water by electrolysis, only alternating current can be used. Current is passed through the green concrete by introducing two or more poles. Experience indicates that the leaner the mix and the smaller the proportion of sand to large aggregate, the higher is the resistance of the concrete; for equal mix and consistency, gravel concrete has a higher resistance than broken stone concrete; and for the same nominal mix and for similar aggregates, a moist concrete has a higher resistance than a wet concrete.

Construction has been standardized on a grand scale in the Soviet Union. With the exception of the newest materials that have not yet been tested sufficiently, all building products are standardized, as well as all types of light reinforced concrete and steel construction and parts of wood structures. Standards for designing common types of buildings and bridges have been prepared by industry and research institutes.

Rebuilding aided by prefabrication

Standardization is an essential of prefabrication, which Russian engineers classify as the most progressive kind of construction and are using as often as possible. Manufacturing prefabricated houses, however, is a new branch of Soviet industry that is not widely developed as yet, although there are many indications that this industry will have a big future.

Many different types of houses will be built, due to the necessity of using various building materials and of meeting the widely varying climatic conditions in the Soviet Union. It is expected that precut and precast panel types of prefabrication will be widely used, and that the sectional type will be used somewhat later.

Several years before the war, the Russians developed a "streamlined method of erection" for large apartment houses in Moscow, using a combination of precut and precast types. The work is divided into six or eight parts, and six or eight apartment houses are built simultaneously. Each part into which the work is subdivided is performed by the same group of workers, who move successively from the first to the last structure.

Among the types of prefabricated homes built before the war are one-story and two-story houses with walls consisting of wood beams placed horizontally. When used for outside walls, the beams are 6x6 in. by 21 ft., except in very cold regions where a thickness of 7½ in. is used. Inside walls have a thickness of about 4 in. The framework consists of 2x4-in. wood studs, placed 27 in. on centers. Tiles known as "fibralit," 2¾ in. by 20 in., with a length varying from 40 to 60 in., and made of pressed wood wool and magnesium cement dried in steam chambers at 300 deg. F., are used as insulation. Stuccoed on both sides, these tiles are also used for interior partitions. The finished flooring, joists, rafters and other elements of the framework are brought precut to the site.

Shop-built panel houses used

Great numbers of panel houses have been built, and use of this type is being increased. In this case all parts of the house are completely shop-built. Panels, finished on both sides and fitted together with tongue and groove, have a core of blanket-type insulation known as "shevlin," which consists of flock (short wool or vegetable fibers) encased in paper and stitched through with thread. Shevlin comes in thicknesses of from ½ to 1 in. and up to 40 in. wide, weighing 7½ lb. per cu. ft.

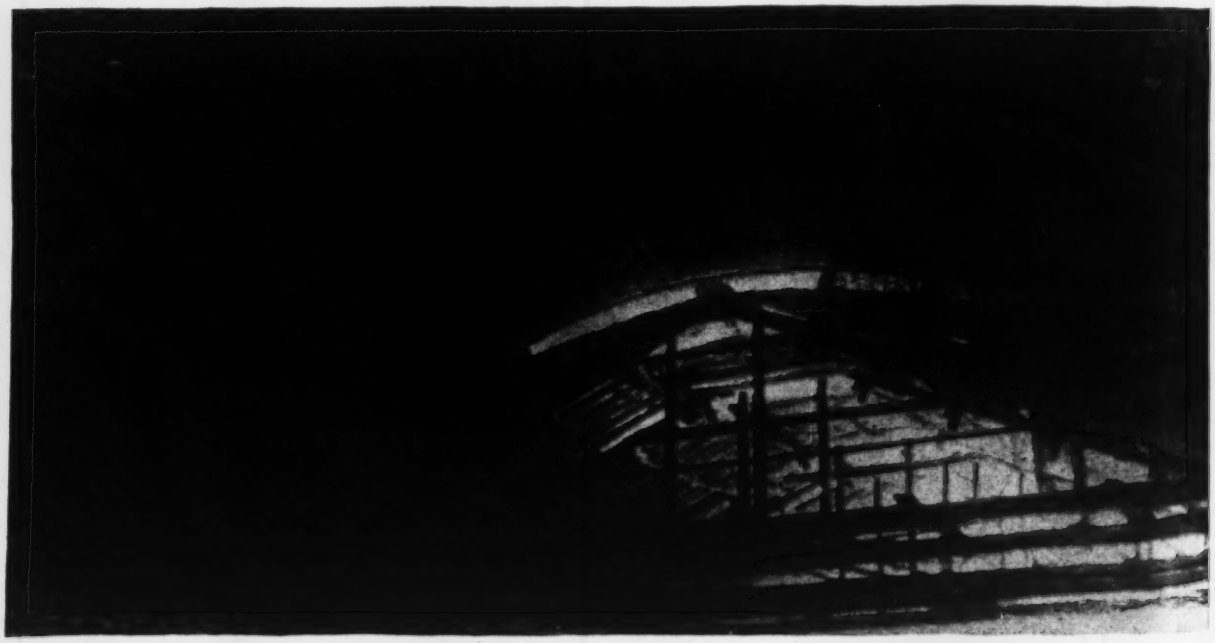
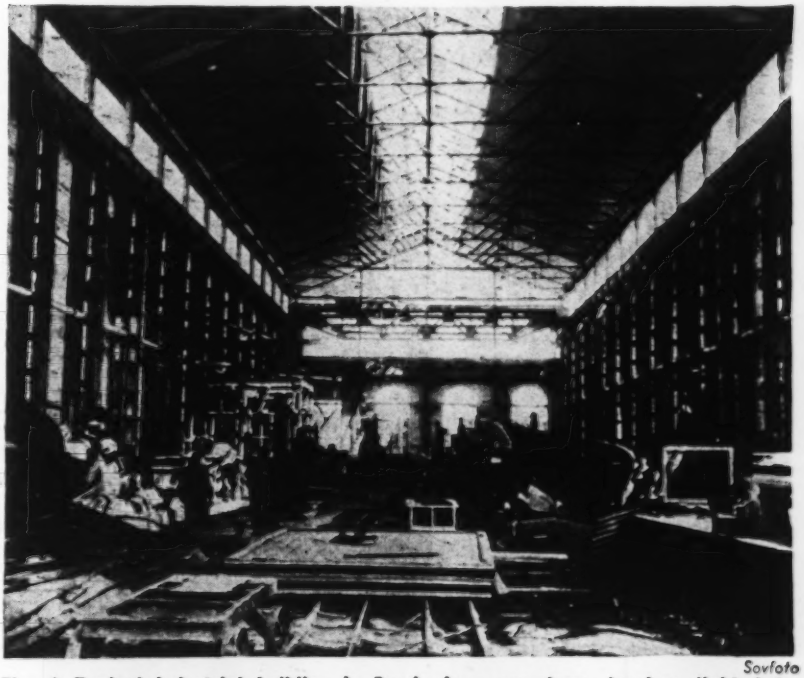


Fig. 3. Brick roof, arched longitudinally and transversely, was developed from studies of native construction in seismic areas.

In most cases, a thickness of 1½ in. is sufficient. Capable of being fireproofed, it can also be used with rock wool or with treated sawdust.

In the restoration of the suburbs of Stalingrad, several houses were built of hollow panels with a flat gypsum surface, filled at the site with slag for insulation. Plywood houses have been constructed of panels composed of four sheets of plywood, with three layers of air between for insulation.

The most usual type of industrial building in the Soviet Union is the one-story structure, designed to provide natural lighting through slanting skylights as well as windows. The skylight width is usually about 60 percent of the span width and the average glass-covered areas generally about 30 percent of the lighted floor area. Russian experience with the inclined skylight indicates that it does not perform very satisfactorily, and before the war many designers were trying to develop skylights of reduced size and also ways of converting to vertical glass sections. During the war, vertical window lighting generally was used.



Sovfoto

Fig. 4. Typical industrial building in Russia is a one-story structure lighted by inclined skylights as well as windows in the walls. Shown above is the turbine department of one of the shops of the Marty shipyards at Nikolayev in the Ukraine, which was wrecked by the Germans and is now being restored.

War changed design trends

In recent years there has been a tendency to reduce the number of buildings on the site. Wartime construction, however, reversed this trend, because of the need of utilizing lighter, simpler elements and structures and of using in many instances lumber products as a substitute for critical materials. The necessity of replacing metal and other scarce materials for built-in roofs, for internal water conduits, for outside sewage disposal systems and for the mechanical devices for opening skylight frames has led to greater use of buildings with a reduced number of openings and also to the introduction of narrow buildings connected wherever necessary with other similar structures. Thus, industrial plants have assumed the appearance of a comb, and the number of teeth of this comb vary greatly.

Such buildings permit easier water drainage along the roof, which may be built of simpler materials, have natural lighting and ventilation through windows, and can be put into operation more rapidly by sections, an important consideration on urgent wartime construction jobs. At some future date the spaces between the separate sections of these comb-like buildings may be built up so as to enlarge the shops.

Standard sizes have been set up for building spans (distances between columns), all of which are multiples of three meters. The most widely used column spacings are 6x12, 6x18, 6x24 and 12x12 meters. Standards are also established for cranes used in buildings and on construction.

These basic measures have made it possible to develop typical sections of one-story industrial buildings for use throughout the entire Soviet Union. Ready-made working and assembly drawings for such structural parts as columns, trusses, skylights and roofs have been utilized by various designing organizations of the country, and they have considerably expedited design and construction.

In shops with light and medium cranes there has been a wide use of precast reinforced concrete columns, whereas for heavy cranes, metal columns are generally specified. Walls are generally made of brick or concrete block. The usual type of roof is a precast reinforced concrete slab, insulated and waterproofed.

In the years immediately preceding the war, considerable use was made of lightweight stamped-metal roofing placed over metal sheathing or over the trusses. Lightweight insulation was inserted, usually in the form of peat or wood fiber slabs cemented to the sheathing with asphalt mastic. Such construction is said to result in a great saving of metal for the roof as well as for the bearing parts of the structure, and the components are simple and easy to handle during erection and assembly.

Source of information

The preceding information on Russian construction was derived in large measure from *Proceedings* of the American-Soviet Building Conference, 1945, held under the auspices of the Building Industry Committee of the National Council of American-Soviet Friendship, Inc., in cooperation with the New York chapter of the American Institute of Architects.

Data on the new reinforced concrete design theory was supplied by A. N. Popov, construction engineer, Government Purchasing Committee of the Soviet Union in the United States of America. The description of "Uzbekistan" vaulting was obtained from *Architecture in the U.S.S.R.*, Chronicle No. 6-7, June-July, 1944, published by the U.S.S.R. Society for Cultural Relations with Foreign Countries, Moscow.

Large-Scale Sewage Chlorination Receives Pilot Plant Test at Hyperion

A sewage chlorination pilot plant on a 1-to-1,000-scale was operated for a 4-day period recently at the Hyperion screening plant to determine the feasibility of chlorinating the entire flow of Los Angeles sewage, amounting to about 160 mgd. Tried for possible use as a temporary solution to the southern California beach contamination problem, the chlorination tests, according to the California Department of Public Health, demonstrated the practicability of chlorination on a large scale and also indicated methods that could be used successfully.

Result of court order

A recent court decision (*ENR* Feb. 21, 1946, vol. p. 270) directed that chlorination equipment be installed at Hyperion prior to June 1, 1946, in order that valuable recreational beach areas on Santa Monica Bay, formerly extensively used, be released from quarantine. This beachland has been quarantined by the State Department of Public Health since Apr. 3, 1943, when an ediet was issued declaring the beach conditions to be a menace to health. On Oct. 13, 1945, the quarantine was extended by some 2 miles so that a total of almost 12 miles of beaches is now affected.

Steps are being taken to permanently remove the cause of this beach pollution by building a mile-long ocean outfall at Hyperion (*ENR* Jan. 31, 1946, vol. p. 155) and a treatment plant using the activated sludge process. More immediate remedial measures are needed, however, to lift the quarantine on the beaches.

Pollution in this area is evidenced by solids and other signs of raw sewage on the beach as well as by bacterial contamination found in surf samples. Recently, visual evidence of sewage on the beaches has been decreased by increased efficiency of the screening plant and because of wartime saving of waste fats and greases. Those beaches on the edges of the quarantined zone which suffer from bacterial contamination alone can be most quickly freed of the quarantine by reducing bacterial contamination at the outfall.

The pilot plant was expected to determine whether chlorination would provide disinfection sufficient to justify freeing the beaches of the quarantine. Investigation had previously shown that if the number of E. coli discharged at Hyperion was reduced 50 percent, the residual E. coli reaching the beaches would be reduced to a point where the quarantine could be lifted from a considerable portion of the restricted area. The extent of beach area thus freed would depend on the degree of disinfection attained.

The pilot plant treated 1/1,000th of the flow reaching Hyperion from a population equivalent of 2,200,000 and hence involved a sewage chlorination set-up equal to that for a town of about 2,200 population. The plant consisted of (1) a 4-in. trash pump that pumps sewage from the main sewage to (2) an elevated, head-regulating tank provided with an overflow pipe leading back to the sewer and a bottom outlet leading to (3) a weir box with a 6-in. rectangular weir. The sewage was chlorinated on entering the weir box by (4) a solution feed chlorinator and on leaving the weir box flowed into (5) a series of four circular tanks. The total time of retention after chlorination was about 10 min.

Yardstick for full-scale operation

The chlorine requirement was determined by the orthotolidin test for residual chlorine. In samples taken at the weir outfall the residual chlorine could be determined after some 8 min. of contact. If there was no residual chlorine, the dosage was immediately increased; if the residual was as much as 1 ppm., the dosage was decreased. It was found that with some residual chlorine present the disinfection was adequate, and that the orthotolidin test offered a practical way of assuring that the test was successful.

To test the bacterial efficiency of this method, samples were taken at the outlet of the circular tanks and tested for E. coli content. The highest E. coli count in the treated sewage was 7,000 per cc. as compared with the raw sewage content of 62,000 minimum and 1,300,000 maximum (average was 400,000 per cc.). None of the E. coli tests showed failure to secure practical disinfection.

From data thus obtained the chlorine required for treating the entire flow of sewage was computed. This varied from a minimum rate of about 5 tons to a maximum of about 24 tons per day for a flow averaging 160 mgd. and averaged about 150 lb. per mg. The operation was carried on in the winter and it was estimated that a summer increase in chlorine demand of 25 percent is not improbable.

Chlorination shown feasible

Results of the pilot plant operation, on the whole, led to conclusions that it had: (1) demonstrated the feasibility of the use of chlorine for disinfecting large sewage flows; (2) given an indication of the chlorine dosage and feed required for disinfection; and (3) offered assurance of the certainty of the results by means of orthotolidin tests.

The conclusion was also reached that the feed of chlorine cannot be simply regulated by varying it in direct proportion to sewage flow or as a multiple of sewage flow without waste of chlorine. Thus the chlorine feed cannot be varied with Venturi meter readings. The operating set-up recommended as a result of pilot plant operation consists of manually operated chlorinators and a pilot plant similar to the one described in the foregoing for use as a guide to the setting of the chlorinators.

As only 50 percent reduction in E. coli at the Hyperion outfall is required to release the valuable beachland recently quarantined, 24-hr. operation will not be necessary. It is believed that chlorination during alternate hours will suffice. In the course of experience it may develop that longer lapses of chlorination are possible at night and most effective results will be attained from more continuous chlorination of day flow.

The pilot plant was operated by the State Department of Public Health in co-operation with the Los Angeles Board of Public Works. C. G. Gillespie is chief of the bureau of sanitary engineering, State Department of Public Health. Working on the pilot plant for the Los Angeles Board of Public Works were Ruben F. Brown, division of sewer maintenance, bureau of maintenance and sanitation, and H. G. Smith, sewer design division, bureau of engineering.

From Field and Office

WORKING PROBLEMS AND TIME-SAVING METHODS FOR ENGINEERS AND CONTRACTORS

Minimum Radius of Curvature For Concrete With Bent Bars

Reinforcement bent along the intrados of an arch tends to pull out of the concrete. This action increases in inverse ratio to the radius of the arc, and below a certain radius a system of reinforcement consisting of crossing straight bars is required, as in the region of a re-entrant corner. This minimum radius is easily computed by considering the shear in the planes along both sides of the bar.

If p is the pressure per inch of arch, r the radius of curvature, a the clear distance to the exterior surface of concrete, v the shear, d the bar diameter and f_s the permissible steel stress, then t, the tensile force acting on a bar, may be found from the formula for tension in a thin-wall pipe.

$$t = \frac{1}{4}\pi d^2 f_s = pr = 2avr,$$

from which it is found that

$$r = \frac{\pi d^2 f_s}{8av}.$$

For $d = \frac{1}{2}$ in., $a = 1$ in., $f_s = 18{,}000$ psi. and $v = 60$ psi., for example, $r = 29.4$ in.—V. Bogvad-Christensen, *Structural Engineer, San Francisco, Calif.*

SUGGESTED MINIMUM RADII FOR CURVES WITH BENT BARS

d_{in}	$\frac{1}{4}\phi$	$\frac{5}{16}\phi$	$\frac{1}{2}\phi$	$\frac{5}{8}\phi$	$\frac{3}{4}\phi$	$\frac{7}{8}\phi$	1ϕ	$1\square$	$1\frac{1}{8}\square$	$1\frac{1}{4}\square$
r_{in}	8	18	32	50	72	98	128			
R_{ft}	0′–8″	1′–6″	2′–8″	4′–2″	6′–0″	8′–2″	10′–8″	13′–6″	16′–6″	20′–0″

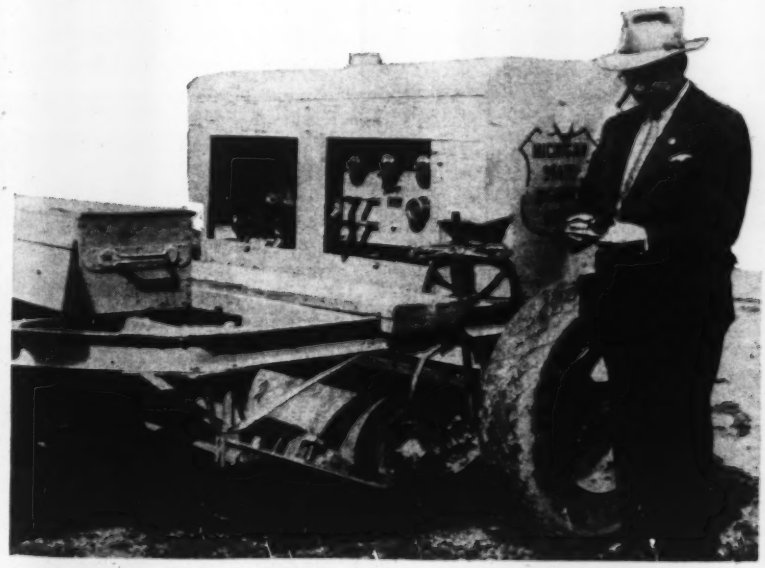
For radius smaller than in table use crossing straight bars.

Traveling Magnet Polices Michigan Highways

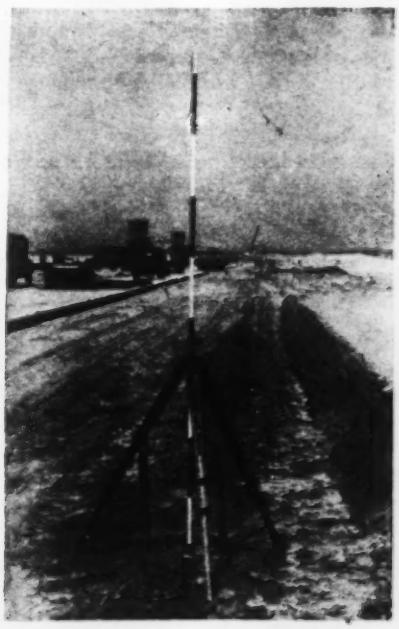
An unestimable number of automobile tire punctures are avoided on Michigan highways each year by the more or less continual operation of a traveling magnet developed and operated by the Michigan State Highway Department. During 1944 some 1,300 lb. of nails, spikes, bolts, pieces of tin cans and other sharp metallic objects were removed from 1,450 mi. of trunkline pavements and 152 mi. of gravel roads, reports Charles M. Ziegler, state highway commissioner, who is shown standing by the magnet in the accompanying picture.

Primarily, the magnet is a large roller mounted on a 2-wheel trailer and towed behind a maintenance truck at 8 mph. A generator, mounted on the trailer, magnetizes the roller which is made to revolve slowly by a belt-drive operating from the wheels on which the trailer moves.

Each time the roller revolves forward it becomes demagnetized at the point where nails and other ferrous metals approach a trough mounted in front of the roller, thus permitting the potential puncture makers to drop into the receptacle. The magnet functions excellently on pavements and loose gravel, picking up anything from a small tack to a crowbar. It will not, however, pick up objects embedded in stabilized gravel roads.



Tire punctures on Michigan roads are reduced by this portable road magnet.



Labor shortage on New York's Idlewild Airport was partly solved by pressing an unemployed tripod into service as a rodman. Wedges align the range pole at the top of the tripod.

Comment and Discussion

Readers' opinions on matters that concern engineers and contractors

Navy Surplus Equipment

Sir: The editorial on "Surplus Construction Equipment" (*ENR* Dec. 27, 1945 vol. p. 858), implies that of all the federal agencies, only the Army Engineers have been mindful of the need for construction equipment by the civilian economy, and that they alone have done something about it.

According to the record, the Navy Department, Bureau of Yards and Docks, had declared surplus to its needs approximately $87,000,000 worth of construction equipment during the period from shortly after the surrender of Japan to the date of publication of the editorial. Included in the declarations were cranes, shovels, tractors, graders, trucks, pumps, compressors, spare parts and many other items suitable for construction purposes.

It is the Bureau of Yards and Docks policy not to hoard equipment for which there is no foreseeable need, but to promptly declare construction equipment surplus as soon as future requirements have been determined. Many million dollars worth of additional construction equipment has been made available to the disposal agencies through surplus declarations since the publication of the editorial.

J. J. MANNING
Rear Admiral, (CEC) U.S.N.
Chief, Bureau of Yards and Docks
Navy Department, Washington, D. C.

Opportunities Unlimited

Sir: The sudden interest in the Armstrong seadrome makes one wonder why it takes so long for many things to obtain recognition. Here is something based on proved principles and of comparative simplicity that has taken almost a quarter of a century to be taken seriously. This was not because the ideas of its inventor were concealed because, if our memory is not playing tricks, *Engineering News-Record*, as well as other journals, called attention to it in years past.

That there was a necessity for ocean landing platforms was long ago recognized by the Germans, and for years they maintained a ship in the South Atlantic equipped to take aboard hydro-planes, refuel them, carry out inspection and repairs, and to re-launch them. But this is only an isolated case.

Predating this instance is the monorail system of rapid transportation. In certain fields it has obvious advantages and furthermore has been in successful operation near Hanover, Germany, for almost a half century. Yet the system is practically unknown.

Again, we have the parking problem in cities. Years ago, *Engineering News-Record* published a schematic plan of a cylindrical garage. If constructed above ground, it was outwardly something like a silo, merely a tall cylinder, probably about 56 ft. in outside diameter, with as many stories as desired.

Presumably, each floor would provide space for seven cars, stored radially. Thus, an 8-story structure could care for 56 cars and would occupy only 3,120 sq. ft. of horizontal area based on the circumscribed square. If these cylinders were assembled in units, like grain bins, and the space between the cylinders utilized, then the area devoted to car storage would be reduced to about 2,500 sq. ft. per stack. If subsurface conditions permitted, these cylinders could be sunk in the ground. Of course, the higher or deeper these cylinders, the more efficient would be use of the land.

All over the country we see timber poles for telephone and electric lines. They cost money, and timber is scarce. They carry appreciable depreciation and maintenance charges, too. Yet, we know of at least one large public utility company, (in Brazil) that has made a huge success of tubular, precast reinforced concrete poles.

For efficiency in the use of materials, we might with profit study some of the little advertised methods of wharf and marine bulkhead construction, as exemplified by the port of Gdynia, and the use of precast concrete sheet piling with articulated supporting frames of heavier piling. In the case of Gdynia, the quays are simply thin concrete shells floated into place and then filled with sand pumped from the ship channel. The concrete sheet-pile bulkhead, with articulated frames taking the main load reactions, has been neglected, though those who know the advantages of this type of construction are aware that, where it can be used, it usually gives the most for the money.

These are only a tithe of what we think about when we observe things about us and begin to wonder if we do not pass over the little things and concentrate too much on the spectacular. We think, sometimes, we get into the state of mind of an official of a public utility who, returning from the inauguration of one of his company's high-head plants, expressed himself as "disappointed because the governing gear occupied more space and was much more impressive than the wheels and generators."

CHARLES JAY SEIBERT
6310 *Eighth St., N. W.*
Washington, D. C.

Veterans and the Slide Rule

Sir: The Red Cross Art and Skill Division had during the war organized large scale entertainment for the bedridden sailors and soldiers in the form of instruction in weaving, leatherwork, etc. I felt that all this effort was very praiseworthy but hardly of any lasting benefit to the veterans. Therefore, I suggested to the Red Cross that instruction in the use of the slide rule would be of permanent value, and patients too sick for almost any other task might be able to handle a slide rule.

The Red Cross responded at once with enthusiasm and promised to furnish the veterans with free slide rules and a small booklet with instructions. I was asked to start in Dante Hospital in San Francisco.

A carpenter made me an instruction slide rule about 2 ft. long with only the ten main divisions and the conventional scales C and D. A one-page instruction sheet was made for the benefit of the bulk of the veterans, who might be scared by the amount of reading matter in the booklet.

I went from bed to bed instructing one patient at a time, and the response was beyond my wildest expectations. Every Saturday afternoon, eight to ten soldiers received instruction, with the

information that any trouble they might run into could be cleared up the following Saturday. About 90 percent of the veterans were interested.

A salesman claimed that he could have made many more sales if he had been able to use a slide rule. A carpenter-contractor with only one leg, who belonged to a family of contractors, cheered up when he realized that he could be estimator for his family.

Later a friend of mine started in the same way at Letterman Hospital, San Francisco.

V. BOGVAD-CHRISTENSEN
Structural Engineer
San Francisco, Calif.

Annuities for Panama Work

Sir: In 1942 I wrote you that there was a bill before Congress to grant pensions to Panama Canal employees who had worked three or more years on the Canal Zone. Subsequently you made mention of this in your publication.

I recently came across my 1942 correspondence with my Congressman and thought I would write him to find out what happened to the bill. To my great surprise the bill was adopted in 1944.

As I never saw any mention of the bill's passage in any engineering publications I think it would be a good idea if you would have a little article as other engineers who are eligible for annuities may not know of it.

Public Law 319-78th Session, Chapter 214-2nd Session, effective May 29, 1944, provides that any person employed on the Canal Zone for three or more years between 1904 and 1914 shall be entitled to receive an annuity for and during the remainder of his life. Aplication is made to the Retirement Division of the U. S. Civil Service Commission at Washington, D. C.

ARTHUR RICHARDS,
Larchmont, N. Y.

Federal Competition

Sir: Just finished reading "Charge U. S. Geological Survey Competes with Private Interests in Well Drilling," (*ENR* March 7, vol. p. 327) and wish to call to your attention a much greater competition with private engineers by the U. S. Soil Conservation Service in the matter of preparing land for irrigation in these western states.

The Soil Conservation Service does the free engineering indiscriminately. At this time here they are furnishing free engineering for a project sponsored by the Goodyear people. Another project they are giving free engineering is for the Isabell-Hartner Co., just north of Phoenix. Mr. Isabell himself told me that last year they grossed over a million and a quarter dollars from their lands. Certainly, it seems far afield for the general tax payer to finance the engineering on such purely speculative ventures.

Undoubtedly the soil conservation act was for the benefit of the small farmer.

The official explanation of the Soil Conservation Service is given in the following letter to Senator Hayden.

PHIL K. STEPHENS
Civil Engineer
Phoenix, Ariz.

Dear Senator Hayden:

This will acknowledge your letter of Feb. 28 with attachments from Phil K. Stephens of Phoenix, Ariz., who protests the use of Soil Conservation Service engineers on land leveling operations.

In planning for the conservation of soil and water resources the leveling of irrigated land is often necessary in order to secure the maximum results from both land and water. While land leveling is an important conservation practice under these conditions it is only one of the practices that may be needed. Soil amendments, the use of cover crops and mulches, rotations of crops and other practices as needed are included in the farm conservation plan. We employ soil scientists, agronomists, and engineers as well as other scientifically trained personnel to do these jobs. The land leveling job must be planned with a view to the crops to be grown, the irrigation methods to be followed, amount and head water available as well as the inherent qualities of the soil if a successful conservation plan is to be secured.

We point this out in order to explain why we cannot always turn over some part of the conservation program to others. However, we may be able to work out an arrangement with the soil conservation district whereby Mr. Stephens can continue to render engineering services on some of the farms being planned for conservation. We will take this matter up with Cyril W. Luker, regional conservator at Albuquerque and Mr. Kennison, state conservationist at Phoenix to see what adjustments can be made. It is our policy to work with local engineers and others privately engaged whenever possible.

Our authorizations are in connection with the conservation of soil and water resources irrespective of tenure. Mr. Stephens has evidently arrived at the wrong conclusion in assuming that we should restrict our work to any class of ownership.

J. C. DYKES
Acting Chief
Soil Conservation Service

Modern House Poll

Sir: Are you really serious about the "house" pictured on the cover of the March 28, 1946 issue of *Engineering News-Record* and the page and a half devoted to it or is it just a "gag"? The latter is suspected since "Engineered" is in quotes. It might better have read, "Imagineered", to borrow a term from Alcoa.

Following are comments of the office force:

"Looks like a Turkish kiosk to me or a hot dog stand at a county fair".

"Is it a merry-go-round or maybe a skating rink?"

"A group of them would look like a ritzy tank farm."

"Is the beeny perched on top a Stetson or a Swiss yodeler's hat?"

"For easy moving, it might be inflated with helium."

"Are tent pegs and ropes provided to tie it down in a wind-storm?"

"An expensive bird-cage."

WALTER RUPPEL
Civil Engineer
San Francisco

Slope Location of Wingwalls

Sir: There are two apparent errors in the article "Simple Method of Locating Wingwalls" (*ENR* Aug. 9, 1945, vol. p. 184). Both stem from the same assumption; namely, that the slope length of the wingwall is the hypotenuse of a triangle having two slope lengths as its other sides.

Actually, the slope length of the wingwall given in Mr. Synyard's example is $\sqrt{(15.65)^2 + (8.00)^2} = 17.58$ ft., not 18 ft. as stated; and the angle is equal to $\tan^{-1} 8/14 = 29$ deg. 45 min., not 31 deg.

THOMAS E. FALEY
Lieut. (jg) USNR
Somerset, Pa.

Book Notes and Reviews

The month's addition to the engineer's reading and reference list

Water Supply and Service

MANUAL FOR WATER PLANT OPERATORS—By A. A. Hirsch, 368 pp. Chemical Publishing Co., Brooklyn, N. Y. $6.50.

WATER SUPPLY AND PURIFICATION—By W. A. Hardenbergh. Second Edition, 488 pp. International Textbook Co., Scranton, Pa. $4.

These two books, while dealing with the same subjects, approach them from entirely different viewpoints. The "Manual", intended as a ready reference in anticipating and solving the operator's day-by-day problems, is written in a clear, concise manner understandable by technical and non-technical men alike. Detailed instructions on procedures and descriptions of processes and equipment make it particularly valuable to the smaller waterworks official and operator.

The second edition of "Water Supply and Purification" brings up-to-date a waterworks compendium designed to meet the needs of the student who wishes to familiarize himself with present day theory and practice as well as the practicing engineer. Incorporating war-born developments in design and operation, the concise, understandable text and illustrative examples effectively show the application of design theory to practice.

A Long Term Housing Program

BREAKING THE BUILDING BLOCKADE—Robert Lasch. 316 pp. The University of Chicago Press, Chicago, Ill. $3.

Coming out just now this book has a misleading title, for the "building blockade" that it discusses has nothing to do with our present emergency housing program. Rather, the book is concerned with a long-term program for low cost housing and principally on slum cleared land. It reviews the well-known conditions that make housing cost too much—high distribution costs of materials, restrictive practices of labor unions, high cost of city land—and it proposes a program for combining government financed and private-financed operations. It sets up as objectives 1½ million living units a year for 10 years, five-room houses for $3,000 including land, rents of $20, $30 and $40 a month for those who can pay no more, and large self-contained communities in place of slums. To achieve these goals, the National Housing Agency would be established as a permanent agency as contemplated in the Wagner-Taft-Ellender Bill, NHA would purchase materials to reduce distribution costs, there would be federal subsidies for the lowest cost housing and for land acquisition, privately-owned redevelopment corporations would be encouraged, and modern urban planning techniques would be made mandatory.

BOOKS FOR EUROPE

To aid the war-damaged libraries of Europe in restoring their usefulness, an agency known as the American Book Center for War Devastated Libraries has been set up in Washington to collect and forward books and periodicals to those libraries.

In the engineering and scientific field, the Book Center needs copies of text books, monographs, technical reports and periodicals, either bound or unbound. Copies of certain local and federal reports also are wanted, but these should not be shipped without first inquiring as to what is needed.

The Book Center does not have funds to purchase such books and periodicals, and it hopes that donors will assume the cost of transportation, but the center will pay these costs if the donor desires.

Periodicals should be tied together by volumes, with missing issues indicated in the case of incomplete volumes.

Shipments should be sent prepaid by the cheapest means of transportation to the American Book Center, care of the Library of Congress, Washington 25, D. C.

Urban Redevelopment

NEW CITIES FOR OLD—By Louis Justement. 232 pp. McGraw-Hill Book Co., New York 18, N. Y. $4.50.

Without denying the importance of rebuilding the world, it is a fact that one of the most challenging jobs of rebuilding exists right at home. In the words of Louis Justement, one of the most enthusiastic proponents of this cause, "rebuilding of America could be a glorious adventure that would give us a new faith in ourselves by establishing a new frontier for constructive achievement."

In his book, "New Cities for Old", Mr. Justement provides convincing arguments that if we have imagination as well as determination we can begin the task that eventually will have to be undertaken as a result of economic pressure. The physical decay that is evidenced in the case of every city, he points out, cannot be arrested by piecemeal planning and redevelopment. Its eradication must be attacked on a wide front and with vigor.

Among other things he proposes the acquisition of land by municipalities, this land to be assembled and then leased until such time that action for large-scale improvements is in order. Prior to such assembly of land, of course, plans will have to be made for reconstruction of large areas. Details of how the land is to be acquired, how buildings may be "retired" and other elements involving political, financial, social and legislative factors are given eloquent exposition. It is Mr. Justement's analysis of these factors that distinguishes the book. That analysis will provoke argument and provide hope that something can be done about urban rehabilitation.

New Engineering Books

PAINT, VARNISH, LAQUER, AND RELATED PRODUCTS—A.S.T.M. Standards. Specifications, methods of testing and definitions of terms. 528 pp. American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa. $2.75.

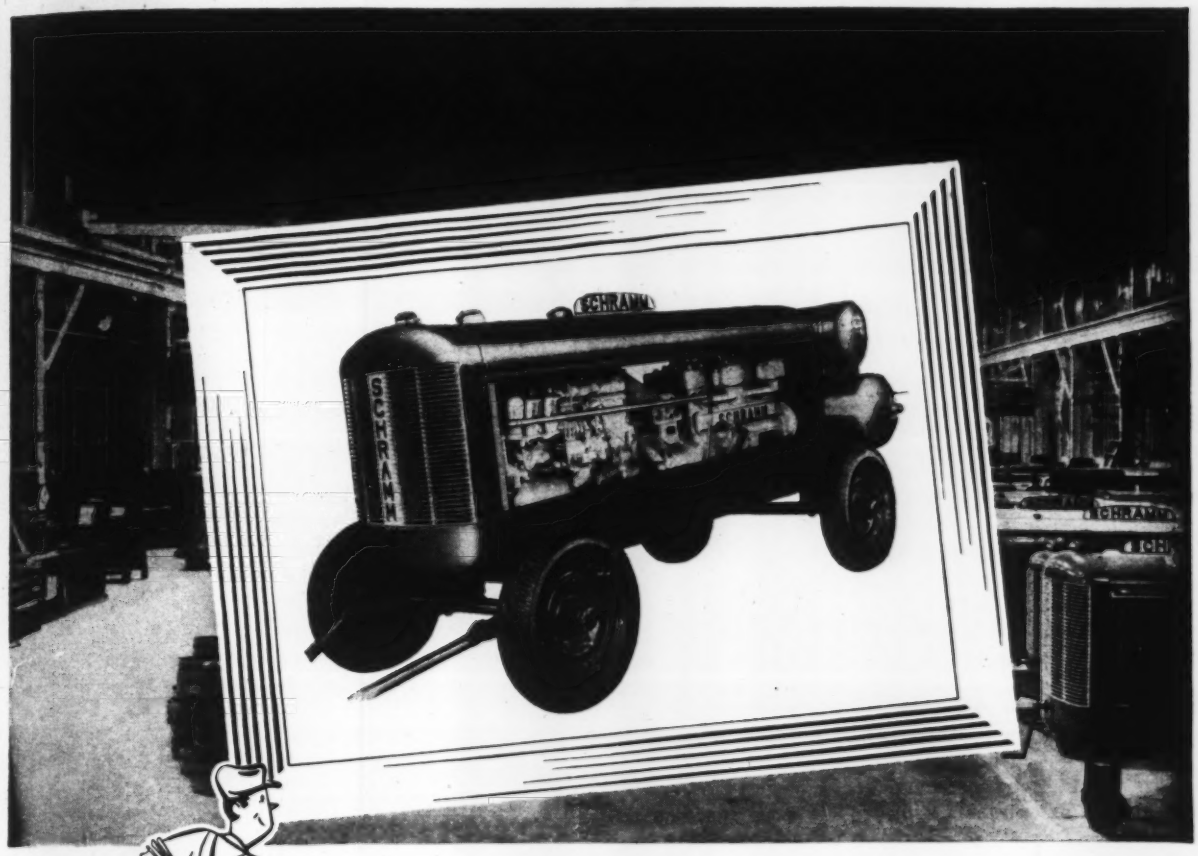
BROOKLYN BRIDGE TECHNICAL SURVEY—Final Report. 1945. 174 pp. Department of Public Works, City of New York. Limited edition. Available only in major engineering libraries.

STEELWAYS OF NEW ENGLAND—Alvin F. Harlow. 461 pp. Creative Age Press, New York. $3.50.

INSPECTION HANDBOOK FOR MANUAL METAL-ARC WELDING—Emergency Standard approved July 10, 1944. 156 pp. American Welding Society, 33 West 39th Street, New York 18, N. Y. $1.50.

ELEMENTARY APPLIED AERODYNAMICS—Paul E. Hemke. 231 pp. Prentice-Hall, New York 11, N. Y. $3.25.

(*Continued on p.* 112)



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UNIT PRICES BID BY CONTRACTORS

Governors Island Shaft—Brooklyn-Battery Tunnel, New York City

OWNER: New York City Tunnel Authority, Engineers Office Building, New York City, Mr. Ralph Smillie, chief engineer.

PROJECT: The excavation in earth and in rock, outside the limits of rock tunnel excavation previously performed by others at the Governors Island Shaft of the Brooklyn-Battery Tunnel, located northeast of Governors Island, including the sinking of a caisson for said shaft to ledge rock and for a certain distance into ledge rock; the furnishing and placing of concrete lining and interior construction inside the Governors Island shaft; the construction of foundation piers and the first floor of the Governors Island ventilation building, the remainder of which will be constructed under another contract; the construction of a fender structure with its appurtenances around the Governors Island shaft and a tidal breakwater between the fender structure and Governors Island; the construction and maintenance of a field office building for the use of the Engineer; and other incidental work.

CONDITIONS: Contractor to furnish all materials with the exception of ceiling tile—to be furnished by the Authority—and to complete the shaft within 20 consecutive calendar months and all other work under the contract in 22 months. The contractor is responsible for anticipating sub-soil materials, subsurface conditions and existing subsurface and submarine structures. Rail, highway and water transportation facilities available. Labor rates for specified in contract are, in part, as follows:

Work in Compressed Air
Work in pressures up to 18 pounds per sq. in.

Blasters	$14.50 per 6 hr. day
Gauge tenders	13.00 per 6 hr. day
Lock tenders	14.00 per 6 hr. day
Lock tenders helpers	13.00 per 6 hr. day
All other men	14.00 per 6 hr. day

For work at pressure greater than 18 lbs. per sq. in. Each man shall be paid an additional amount per day in accordance with the following table:

Air pressure	Additional Payment per day
18 lbs. and up to 26 lbs.	$1.00
26 lbs. and up to 33 lbs.	1.50
33 lbs. and up to 38 lbs.	2.00
38 lbs. and up to 43 lbs.	2.50
43 lbs. and up to 48 lbs.	3.00
48 lbs. and up to 50 lbs.	3.50

Other wage rates for work in free air ranges from 50c per hour for 1st year apprentices to $1.50 for semi-skilled labor and to $2.02½ for skilled.

BIDS: Seven bids were received December 11, 1945, ranging from $2,994,003.00 to $4,749,088.20.

LIST OF BIDDERS:

1. Wagner Co., New York, N. Y. $2,994,003
2. George H. Flinn Corp., New York, N. Y. 3,989,938
3. Stiefel Construction Corp., New York, N. Y. 4,199,139
4. Mason & Hanger Co. Inc., New York, N. Y. 4,391,510
5. Walsh Construction Co., New York, N. Y. 4,504,808
6. Spencer White & Prentis, Inc., New York, N. Y. 4,746,139
7. J. Rich Steers, Inc. and Peter F. Connolly, New York, N. Y. 4,749,088

Item	Quantities	Unit Prices (1)	(2)	(3)
1. Dredging incl. disposal	Lump Sum	$30,000.00	$159,000.00	$50,000.00
2. Shaft excavation in earth incl. disposal in any place selected by Contractor	9,800 c. y.	30.00	43.00	50.00
3. Shaft excavation in rock above final elev. of caisson cutting edge	1,600 c. y.	60.00	117.00	150.00
4. Shaft excavation in rock below final elev. of caisson cutting edge	8,500 c. y.	30.00	48.50	25.00
5. Cement used in concrete	21,800 bbl.	4.00	5.00	3.50
6. Concrete excl. cement	14,500 c. y.	30.00	23.00	35.00
7. Portland cement grout ejected through skin plates of caisson	150 bbl.	40.00	20.00	20.00
8. Permanent structural steel in caisson portion of shaft	2,050 ton	280.00	340.00	350.00
9. All structural steel not otherwise provided for	1,930 ton	240.00	250.00	299.00
10. Miscellaneous steel and iron	54,000 lb.	.30	.27	.40
11. Reinforcing rod trusses welded to skin plates of caisson	4,900 l. f.	1.00	2.50	8.00
12. Steel reinforcing bars not included in (11)	180 ton	200.00	200.00	150.00
13. Wire mesh used in reinforcing concrete other than under (14)	2,800 lb.	.30	.50	.15
14. Wire mesh for beam and column wrapping	8,400 lb.	.30	.58	.20
15. Furnishing and installing stainless steel ceiling hanger units	4"each	200.00	51.00	80.00
16. One-ply waterproofing	2,300 s. y.	2.00	2.36	1.60
17. Six-ply waterproofing	110 s. y.	6.00	5.45	5.00
18. Waterproofing brick in mastic	440 c. y.	150.00	170.00	125.00
19. Installing 4½-in. x 4½-in. ceramic ceiling tile without grippers, furnished by Authority	2,200 s. f.	1.00	1.25	1.00
20. Installing 6-in. x 6-in. glass ceiling tile with grippers furnished by Authority	2,200 s. f.	1.00	.85	.80
21. Furnishing and installing 4-in. diam. c.i. bell and spigot cement lined pipe incl. fittings and specials	50 l. f.	4.00	3.72	1.00
22. Furnishing and installing 6-in. diam. c.i. bell and spigot cement lined pipe incl. fittings and specials	190 l. f.	6.00	4.91	1.50
23. Furnishing and installing 8-in. diam. c.i. bell and spigot cement lined pipe incl. fittings and specials	220 l. f.	8.00	6.35	2.10
24. Furnishing and installing 4-in. diam. flanged cement lined pipe incl. fittings, valves and specials	140 l. f.	4.00	5.19	1.50
25. Furnishing and installing 6-in. diam. flanged cement lined pipe incl. fittings, valves and specials	420 l. f.	6.00	6.56	2.20
26. Furnishing and installing 8-in. diam. flanged cement lined pipe incl. fittings, valves and specials	550 l. f.	8.00	8.20	3.40
27. Furnishing and installing 12-in. diam. flanged cement lined pipe incl. fittings, valves and specials	10 l. f.	20.00	15.48	7.50
28. Furnishing and installing 2-in. diam. galvanized W.I. pipe incl. fittings, valves, specials and metal supports	340 l. f.	2.00	1.90	1.10
29. Furnishing and installing 2½-in. diam. galvanized W.I. pipe incl. fittings, valves, specials and metal supports	30 l. f.	3.00	2.80	1.15
30. Furnishing and installing 3-in. diam. galvanized W.I. pipe incl. fittings, valves, specials and metal supports	40 l. f.	3.00	3.65	1.50
31. Furnishing and installing 3-in. diam. cement lined W.I. pipe incl. fittings, valves, specials and metal supports	390 l. f.	4.00	3.90	1.12
32. Furnishing and installing 4-in. diam. galvanized W.I. pipe incl. fittings, valves, specials and metal supports	160 l. f.	6.00	4.20	2.00
33. Furnishing and installing 10-in. diam. cement lined W.I. pipe incl. fittings, valves, specials and metal supports	40 l. f.	15.00	14.00	6.50

Continued on page 101

Tunnel Shaft New York, N. Y.

(*Continued from page* 98)

Item	Quantity	Unit Prices (1)	(2)	(3)
34. Galv. C.I. boxes — Type SL	350 lb.	2.00	1.48	2.00
35. ½-in. diam. silican bronze electric tubing incl. bronze boxes and fittings in place	720 l. f.	1.50	1.19	3.00
36. 1-in. diam. silican bronze electric tubing incl. bronze boxes and fittings in place	970 l. f.	2.00	2.18	5.00
37. 1¼-in. diam. silican bronze electric tubing incl. bronze boxes and fittings in place	430 l. f.	2.50	4.08	6.80
38. 2-in. diam. silican bronze electric tubing incl. bronze boxes and fittings in place	30 l. f.	4.00	5.00	10.00
39. 2-in. diam. asbestos cement conduit in place	380 l. f.	.60	.66	2.50
40. 2½-in. diam. asbestos cement conduit in place	120 l. f.	.80	.94	2.70
41. 3-in. diam. asbestos cement conduit in place	1,200 l. f.	1.60	.95	2.80
42. 3½-in. diam. asbestos cement conduit in place	300 l. f.	1.20	1.13	3.00
43. 4½-in. diam. asbestos cement conduit in place	1,990 l. f.	1.60	1.29	4.00
44. 1½-in. diam. galvanized steel conduit incl. fittings in place	350 l. f.	1.00	.78	3.00
45. 3-in. diam. galvanized steel conduit incl. fittings in place	250 l. f.	2.00	1.46	7.00
46. 3½-in. diam. galvanized steel conduit incl. fittings in place	50 l. f.	3.00	1.84	10.00
47. 4½-in. diam. galvanized steel conduit incl. fittings in place	100 l. f.	4.00	2.68	12.00
48. 5-in. diam. galvanized steel conduit incl. fittings in place	80 l. f.	5.00	3.43	15.00
49. Furnishing and installing 500 M.C.M. ground cable	150 l. f.	2.00	1.60	5.00
50. Furnishing and installing 250 M.C.M. bare ground cable	200 l. f.	1.00	1.32	3.40
51. Furnishing and installing N 4/6 ground cable	10 l. f.	1.00	1.35	15.00
52. Fender structure, incl. permanent wharf, except piles	Lump Sum	340,000.00	560,000.00	400,000.00
53. Tidal breakwater, except piles	Lump Sum	14,600.00	100,000.00	15,000.00
54. Furnishing and driving untreated white oak class B piles for permanent wharf	1,100 l. f.	3.00	1.36	1.25
55. Furnishing and driving creosoted yellow pine class A piles for fender structure	42,000 l. f.	3.00	2.60	2.10
56. Furnishing and driving creosoted yellow pine class B piles for fender structure and breakwater	4,000 l. f.	3.00	1.91	2.10
57. Furnishing and driving untreated class C piles for field office building	1,260 l. f.	3.00	2.19	1.40
58. 5 ft.-6 in. diam. foundation piers for Gov's. Is. ventilation building, in place	740 l. f.	100.00	100.00	200.00
59. Furnishing and installing miscellaneous copper	370 lb.	2.00	1.60	1.50
60. Furnishing and installing miscellaneous brass	80 lb.	2.00	1.60	1.50
61. Furnishing and installing miscellaneous bronze	70 lb.	2.00	2.20	2.50
62. Furnishing and installing miscellaneous exhaust air parts	8 each	60.00	60.00	55.00
63. Construction and maintenance of field office building	Lump Sum	15,000.00	148,000.00	59,240.00

Sea Wall, Hampton New Hampshire

OWNER: New Hampshire State Highway Department, Concord, N. H., Harold E. Langley, Bridge Engineer.

PROJECT: No. N. H. 527, construction of 3530-ft. steel and concrete sea wall in Town of Hampton, N. H.

CONDITIONS: Contractor to furnish all materials and to complete the job 150 working days after Mar. 1, 1946. Transportation facilities include B&M R. R. and Highway, Route 1A. Skilled labor rates range from equipment operators at $1.875, structural steel workers, $1.65, to journeymen carpenters at $1.20. Intermediate grade labor ranges from equipment operators at $1.50 to truck drivers at $0.90 with unskilled labor at $0.70 and $0.75.

BIDS: Twelve bids, opened January 24, 1946, ranged from $187,268.40 to $261,916.10. Bids were based on sand borrow for backfill with alternate bids taken on gravel borrow for backfill.

LIST OF BIDDERS:

		Alternate
1. Munroe-Langstroth, Inc., No. Attleboro, Mass. (contract)	$187,268.40	$188,522.48
2. Henley-Lundgren Co., Worcester 8, Mass.	229,482.15	230,742.15
3. A. D. Daddario, Boston, Mass.	235,400.61	235,400.61
4. New England Foundation Co., Inc., Boston, Mass.	242,681.90	242,681.90
5. Landers & Griffin, Inc., Portsmouth, N. H.	244,169.60	245,681.60
6. Marson Const. Co., Somerville, Mass.	251,740.99	251,740.99
7. Berke-Moore Co., Inc., Brookline, Mass.	254,473.49	259,513.49
8. Coleman Bros. Corp., Boston, Mass.	259,991.06	265,031.06
9. Harry R. Lee, Manchester, N. H.	260,641.07	264,421.07
10. Charter Oak Const. Co., Inc., Hartford, Conn.	261,708.33	264,228.33
11. Coughlan Construction Co. Inc., Boston, Mass.	261,916.10	263,579.30
12. Buck-MacDonald Co., Boston, Mass.	Informal	Informal

Item	Quantity	Unit Prices (1)		(2)	
8.3 Unc. structure excavation	4,100 cu. yd.	$1.40	$5,740.00	$2.00	$8,200.00
11.2 Sand borrow for backfill	5,040 cu. yd.	.50	2,520.00	.60	3,024.00
14.1 Gravel borrow	259 cu. yd.	1.00	259.00	.90	233.10
14.1 Gravel borrow for backfill (alternate)	5,040 cu. yd.	.75	3,780.00	.85	4,284.00
19.1 Gravel surface course	671 cu. yd.	1.00	671.00	1.25	838.75
32.1 Concrete class A	1,088 cu. yd.	22.50	24,030.00	34.00	36,312.00
35 Reinforcing steel	61,827 lbs.	.08	4,946.16	.10	6,182.70
36.1 Structural steel	213,206 lbs.	.07	14,924.42	.10	21,320.60
37 Structural timber	141 mbm.	144.00	20,304.00	150.00	21,150.00
42.2 Steel sheet piling	765 tons	91.00	69,615.00	110.00	84,150.00
43.1 Treated timber bearing piles	8,160 lin. ft.	1.45	11,832.00	1.75	14,280.00
44 Bridge railing E	4,000 lin. ft.	5.10	20,400.00	4.50	18,000.00
49.4 Riprap D	648 cu. yd.	3.50	2,268.00	8.00	5,184.00
73 6" concrete sidewalk	3,104 sq. yd.	2.85	8,846.40	3.00	9,312.00
301 Stone chips	259 cu. yd.	3.50	906.50	5.00	1,295.00

Road Improvement, Pleasants Co., West Virginia

OWNER: West Virginia State Road Commission, Charleston, W. Va.

PROJECT: Construction of 4.816 miles of the St. Marys—Ritchie County line road; including clearing, grubbing, grading, draining and gravel surfacing.

BIDS: Eleven bids were received on February 19, 1946, ranging from the contract low of $357,974.00 to the high of $693,938.00.

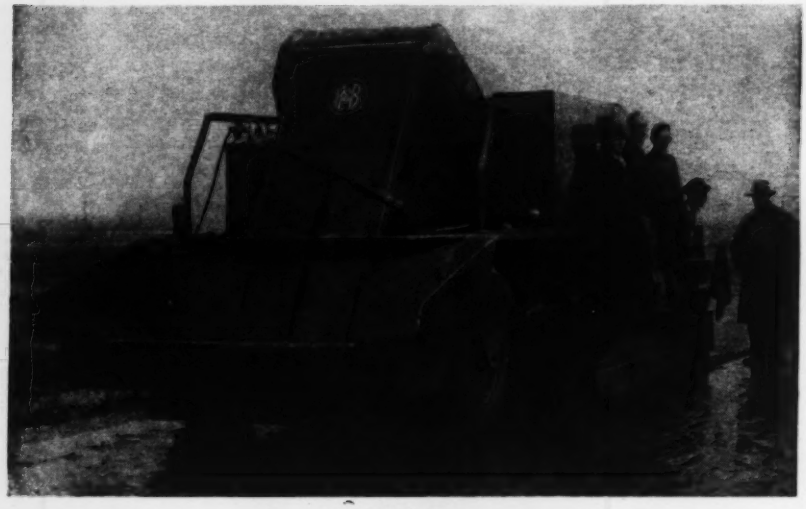
LIST OF BIDDERS:

1. Boso & Ritchie, Inc., Ravenswood, W. Va. (contract)	$357,974.00
2. Keeley Const. Co., Clarksburg, W. Va.	466,971.00
3. Sutton Co., Oceana, W. Va.	481,125.00
4. Wilson & Son, St. Marys, W. Va.	499,972.50
5. A. S. Wikstrom, Bound Brook, N. J.	531,196.00
6. Coleman, Gay, Gregory & Poole, W. Va.	535,034.60
7. Vecellio & Grogan, Berkley, W. Va.	564,062.70
8. Western Const. Co., Nashville, Tenn.	578,991.29
9. Murphy Const. Co., Morgantown, W. Va.	598,936.70
10. Price Construction Co., Huntington, W. Va.	664,656.75
11. Smith Const. Co., Huntington, W. Va.	693,938.00

Item	Quantities	Unit Prices (1)	(2)	(3)
1. Clearing and grubbing	69 acres	$100.00	$100.00	$100.00
2. Unclassified excavation	544,000 cu. yds.	.44	.58	.65
3. Borrow	10,000 cu. yds.	.40	.45	.40
4. Overhaul	1,000,000 st. yds.	.01	.01	.005
5. Structure excavation	3,200 cu. yds.	2.50	3.00	2.50
6. Traffic bound gravel base	22,077 tons	2.00	3.00	2.50
7. Corr. metal pipe paved invt. 18"	1,100 lin. ft.	2.75	3.50	2.50
8. Corr. metal pipe paved invt. 24"	300 lin. ft.	4.00	6.50	4.25
9. 18" Conc. pipe-std. str.	2,500 lin. ft.	3.00	3.00	3.80
10. 24" Conc. pipe-extra strg.	108 lin. ft.	5.00	5.00	5.00
11. Class A concrete	585 cu. yds.	30.00	35.00	29.50
12. Class B concrete	140 cu. yds.	29.00	35.00	28.00
13. Reinforcing steel	151,000 lbs.	.06	.08	.09
14. 8" plain concrete pipe-perf.	900 lin. ft.	1.25	1.25	1.00
15. Crushed stone for underdrain	300 cu. yds.	5.00	6.00	4.00

New Aids to the Constructor

MANUFACTURERS' LATEST DEVELOPMENTS IN EQUIPMENT AND MATERIALS

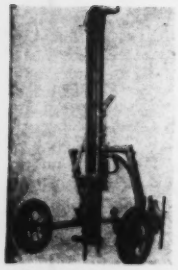


Moto-Paver

A new travel plant is a completely self-contained continuous mix machine, approximately 8 ft. wide and 22 ft. long, mounted on pneumatic tires and driven by two gasoline engines. One engine is for driving the mixer and related units, the other for moving the machine along the road. One advantage gained by this two-engine design is that the plant can be made to travel at any desired paving speed without varying the mixer speed.

Advantages claimed for the machine are its flexibility, both in the various ways in which it can be used and in the different types of pavements which it can produce; extreme mobility, permitting it to travel from one job to another under its own power; incorporation of the paving machine as an integral part of the plant, eliminating the necessity of using a separate paver; comparatively low initial investment for the job it will do, plus the fact that no additional units are needed; better work due to the fact that in normal operation the aggregate is dumped directly from trucks into the machine rather than onto the road surface, which insures that there will be no dry material left between the prime base and the newly mixed material.—*Hetherington & Berner, Inc., 730 Kentucky Avenue, Indianapolis 7, Ind.*

Wagon Drill



This drill uses a heavy duty drifter, the cylinder of which is 4-in. in dia. It has rifle bar rotation and a positive-acting end-seating valve with circumferential seal. The cylinder-controlled blowing device gives exceptional hole cleaning ability. Added features are: one-piece chucksleeve, positive drill steel locking chuck for 1¼ in. hollow round lug shank drill steel, one air hose to backhead with swivel to prevent fouling. Heat-treated alloy steel is used in all major parts, and slow rotation parts are available. The drifter may be converted easily to wet drilling. Strong rotation, low air consumption and exceptional drilling speed are said to give low cost per foot of hole drilling.—*Worthington Pump and Machinery Corp., Harrison, N. J.*

• • •

Shovel and Crane

Embodying many new engineering and design principles, the TL-20 shovel and crane can be equipped with a choice of five interchangeable booms and ten different types of mounting. Because of its turntable design, the unit assembly principle permits each major component to be removed as a unit and replaced with a similar complete unit. Among other turntable features are a one-piece, all-welded turntable bed and hook rollers.

The TL-20 may be mounted on crawler or on rubber tires. Crawler mounting is a chain-driven unit with two speeds in both directions. Rubber-tire mountings cover all combinations and types of four and six-wheel units.—*The Thew Shovel Co., Lorain, Ohio.*

• • •

Single Jaw Crusher

To eliminate extra jaw plate wear and loss of finished product by fine grading, the principle of "crushing without rubbing" has been incorporated in the improved design of the single-jaw "Simplex" crusher. Its capacity is 60 to 80 tons per hour. Other advantages claimed are: Smaller motor required; tramp iron overload protection; can be choke fed; automatic lubrication; failure protection; dustfree lubrication; all-steel frame construction; less weight; and smaller overall dimensions.—*Straub Mfg. Co., 507 Chestnut St., Oakland, Calif.*

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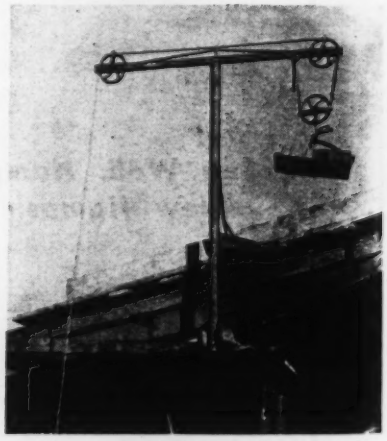

Portable Hoist

With a new portable hoist in position, one man on the ground can load a variety of materials—brick, mortar, face brick, etc.,—and then unload them automatically on the roof of a building, thus saving labor.—*Clipper Manufacturing Co., 4030 Manchester, St. Louis, Mo.*

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Manufacturers' Activities

R. G. LeTOURNEAU, INC., has announced the appointment of Oscar W. Nelson as vice-president and general manager of its Peoria plant. He was formerly general manager of the Beaver, Pa., plant, propeller division, Curtiss - Wright Corp. He will be responsible for all Peoria operations, his duties including those of Denn M. Burgess, who recently resigned as executive vice-president and director. Prior to his wartime association with Curtiss-Wright, Nelson was vice-president and general manager of the Muhler Co., Milwaukee, Wis., while handling other assignments as financial consultant, sales and production advisor.

J. A. ZURN MFG. CO., Erie, Pa., announces these appointments: Earl Morris, district representative at Los Angeles, Calif.; Thomas A. Kennedy, regional engineer for the New York factory office; Harold Bergman, Cleveland, Ohio, district representative; J. Howard Butcher, district representative, Philadelphia, Pa., and John P. Tansey, district representative, Pittsburgh, Pa.

ESTABLISHMENT in Chicago of a manufacturing research project devoted to the improvement of manufacturing methods and procedures for International Harvester Co. products, has been announced by K. O. Schreiber, vice president in charge of manufacturing. The company's manufacturing research activities will be carried on in the plant operated during the war by Foote Bros. Gear & Machine Corp. for the manufacture of aviation parts, located at 5225 South Western Avenue. The Harvester project will occupy about 230,000 sq. ft. of floor space and the company will invest a substantial sum of money in the improvement of the property and for equipment and facilities.

E. R. GALVIN, formerly president of Tyson Bearing Corp., Massillon, Ohio, has been named executive vice-president, general sales manager and director of LaPlante-Choate Manufacturing Co., Inc., Cedar Rapids, Iowa. S. L. Myers, who has been vice-president and general sales manager during the last year, will be-

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LA..... Baton Rouge & Monroe—Dunham-Pugh Co.
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MD..... Baltimore—Phillips Machinery & Tractor Co.
MASS.. Newton Upper Falls—United Equip. Corp.
MICH.. Bark River—Bark River Culvert & Equipment Co.
Detroit and Grand Rapids—
Wolverine Tractor & Equipment Co.
MINN.. Minneapolis & Duluth—Roshot Equipment Co.
MISS.. Jackson—Mississippi Road Supply Co.
MO.... St. Louis—Missouri-Illinois Tractor & Equip. Co.
Kansas City—Noel V. Wood, Inc.
MONT.. Billings & Missoula—Industrial Equipment Co.
NEB.... Omaha—Nebraska Tractor & Equipment Company
North Platte—Cornhusker Tractor & Equip. Co.
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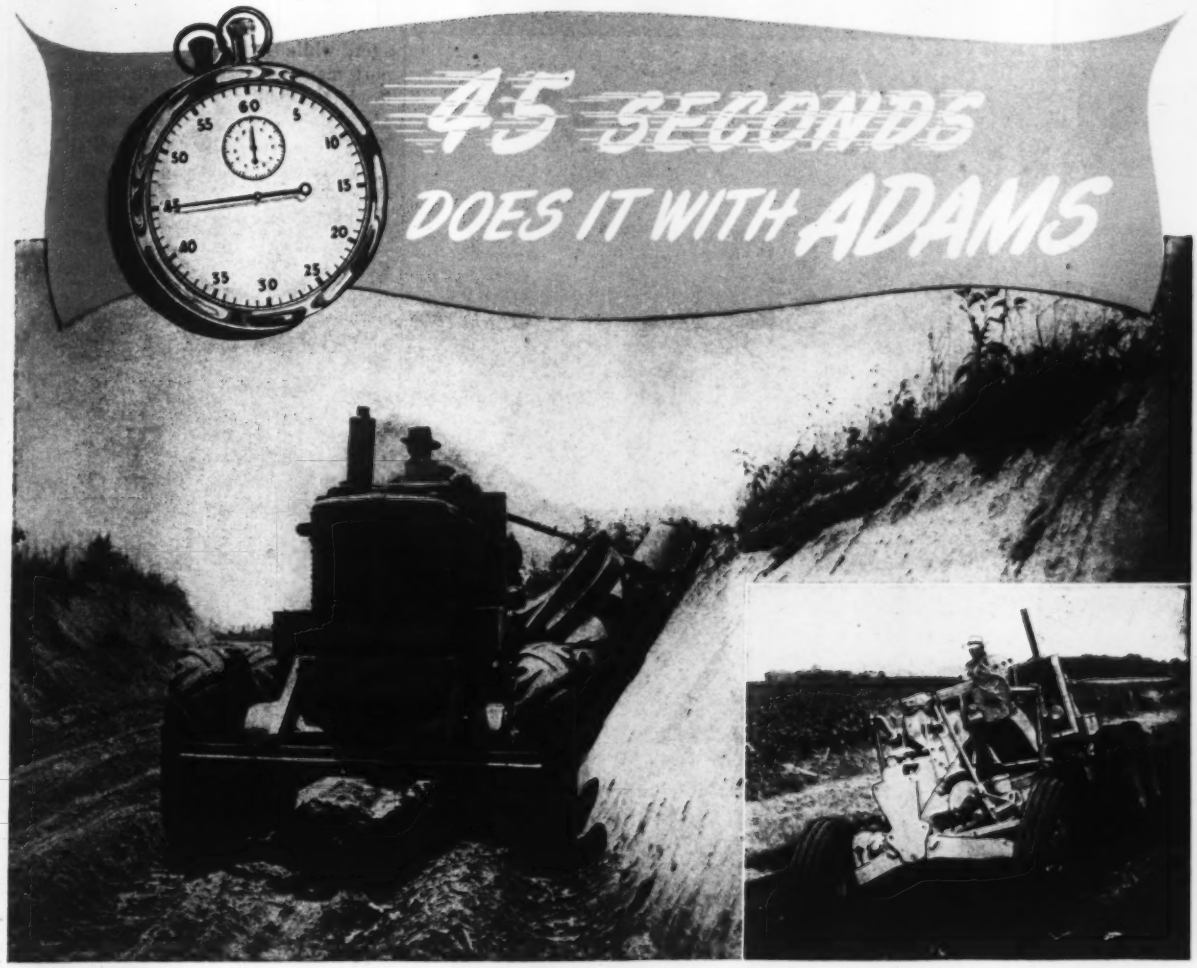
El Paso—Hardin and Coggins
UTAH.. Salt Lake City—The Lang Company
VA..... Richmond—Municipal Sales Company
Richmond and Roanoke—Rish Equipment Co.
Alexandria—Phillips Mach. & Tractor Co.
WASH. Seattle—Howard-Cooper Corp.
Spokane—Intermountain Equip. Co.
W. VA.. Charleston and Clarksburg—Rish Equipment Co.
WIS..... Eau Claire—Bark River Culvert & Equipment Co.

SEE Adams AD ON OPPOSITE PAGE



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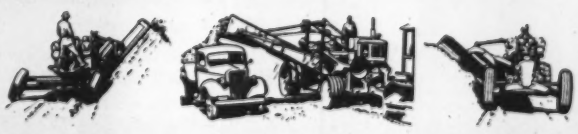

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It is your responsibility to control the air content of the concrete.

Read the new "specs" on the amount of air that must be entrained, and then use Darex AEA as a gauge-water addition. You can meet the specifications and keep the control of the air content in your hands. It's the only way you can compensate for changes occurring in the field.

Darex AEA costs only a few cents per yard. It is safe, harmless. Comes ready to use. Darex Air Entraining Concretes save you time and labor because they are plastic, workable, reduce segregation and bleeding, speed up finishing, give durable concrete. — DEWEY AND ALMY CHEMICAL COMPANY, Cambridge 40, Massachusetts.

Use Darex AEA with Confidence

Measuring meters available

Simple metering devices for Darex AEA are available. Write for details.

Where Accuracy and Dependability Count!

Use THE WHITE TRANSIT

Built to rigid specifications—featuring coated optics—here is a truly fine instrument providing the utmost in versatility and dependability. Designed particularly for Municipal, Railroad, Highway and Bridge work.

DAVID WHITE COMPANY

come vice-president and export sales manager, while Jay M. Fetters, former export manager, will become manager of foreign development. At earlier periods Mr. Galvin was general sales manager of R. G. LeTourneau, Inc., Caterpillar Tractor Co., and the Cleveland Tractor Co.

APPOINTMENT of J. T. Myers as assistant general manager of the Davey Compressor Co., Kent, Ohio, was announced recently by S. V. Saginor, general manager.

A mechanical engineering graduate of Duke University, Mr. Myers has just been released from the Navy with rank of lieutenant. His service included acting as engineering officer aboard a minesweeper and later as an experimental engineer assigned to the Naval Academy, Annapolis. Mr. Myers first joined the Davey Compressor Co. in 1941.

O. P. DONOHUE has been promoted to the sales promotion staff of the Allis-Chalmers Mfg. Co., Milwaukee, Wis. He will specialize in heating, ventilating and air-conditioning. Prior to his service in the Navy, Mr. Donohue joined Allis-Chalmers in 1941 and has served in the company's product departments.

ALBERT STORMS & Co., 101 Park Ave., New York City, is now making aluminum windows, including double hung, casement, basement and projected windows, and windows for glass block construction.

CATERPILLAR TRACTOR CO., announces that Gordon J. Fowler, formerly district representative for the eastern sales division, will serve California Caterpillar distributors at Fresno, Hanford, Merced, Stockton, Visalia, and Modesto; and H. S. Eberling, also a former eastern district sales representative, will be at Salt Lake City to serve distributors there and at Boise and Idaho Falls, Idaho. J. W. Muller, former district sales representative, has resigned to join the Johnson Tractor Co., a Caterpillar distributor at Riverside, Calif.

•

JOSEPH F. HEIL has been elected president of The Heil Co., Milwaukee, Wis. Julius P. Heil, founder of the company and president since its inception, will continue as director and treasurer.

H. W. HISCOX has been appointed sales representative for the Euclid Road Machinery Co. for Virginia and West Virginia; George M. Perry has joined the

FWD THE *One* TRUCK FOR *Many* JOBS

SPRING • SUMMER • FALL and WINTER

Wherever highway construction and maintenance men operate, the outstanding ability of FWD trucks with under-body blade equipment is well known and valued. On their blading ability alone, FWDs rate as first choice for highway duty . . . but the same truck that does this work so well does scores of other highway jobs equally well, throughout all seasons of the year.

Back of FWD superior performance is the experienced, specialized FWD engineering that provides the highest development of the true four-wheel-drive principle with center differential . . . engineering that equalizes power and load distribution, puts driving power and traction on all wheels, divides working-strains over two driving axles . . . engineering that gives FWDs the power, ruggedness, dependability and economy that makes these all-purpose trucks the first choice of highway authorities.

See your FWD dealer, or write for information on FWD trucks now ready to go to work for you.

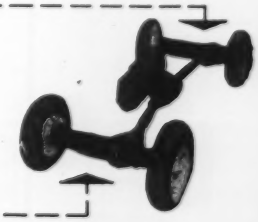
There was genuine pride in the voice of driver Bob McBride as he told the FWD photographer "I sure do like that truck!" It's the newest and biggest of the Logan County, Colorado, Highway Department's fleet. For 15 years Logan County has used every one of its FWDs to do many jobs, from grading and weed removal to heavy snow clearing.

THE FOUR WHEEL DRIVE AUTO CO., Clintonville, Wis., U.S.A.

Canadian Factory: KITCHENER, ONTARIO

FOUR-WHEEL-DRIVE

A "plus" that pays in many ways



THE ORIGINAL EXCLUSIVE BUILDERS OF FOUR-WHEEL-DRIVE TRUCKS

"MORE POWER ON MORE WHEELS"

"Friden Features... make my job easy!

There's a difference in calculators...operate a Fully Automatic Friden and you'll discover how effortlessly you can produce *accurate, useful answers* for all types of Figure Work problems. Just ask your local Friden Agency for a demonstration of these exclusive Friden Features...on your own work."

Friden Mechanical and Instructional Service is available in approximately 250 Company Controlled Sales Agencies throughout the United States and Canada.

FRIDEN CALCULATING MACHINE CO., INC.

HOME OFFICE AND PLANT • SAN LEANDRO, CALIFORNIA, U. S. A. • SALES AND SERVICE THROUGHOUT THE WORLD

export department; and Thomas A. Cantrell is in charge of field engineering.

THE APPOINTMENT of W. H. Klein as vice-president of research and development, headquarters in New York City, and Carl J. Lofstedt, general operating manager, with headquarters in Nazareth, Pa., has been announced by the Pennsylvania-Dixie Cement Corp.

THE APPOINTMENT of Fred J. Maple as manager of exhibits is announced by the John A. Roebling's Sons Co., Trenton, N. J., also that of Albert Neroni to succeed Mr. Maple as manager of advertising. Mr. Neroni was formerly assistant manager of advertising for Anaconda Wire and Cable Co., Inc.

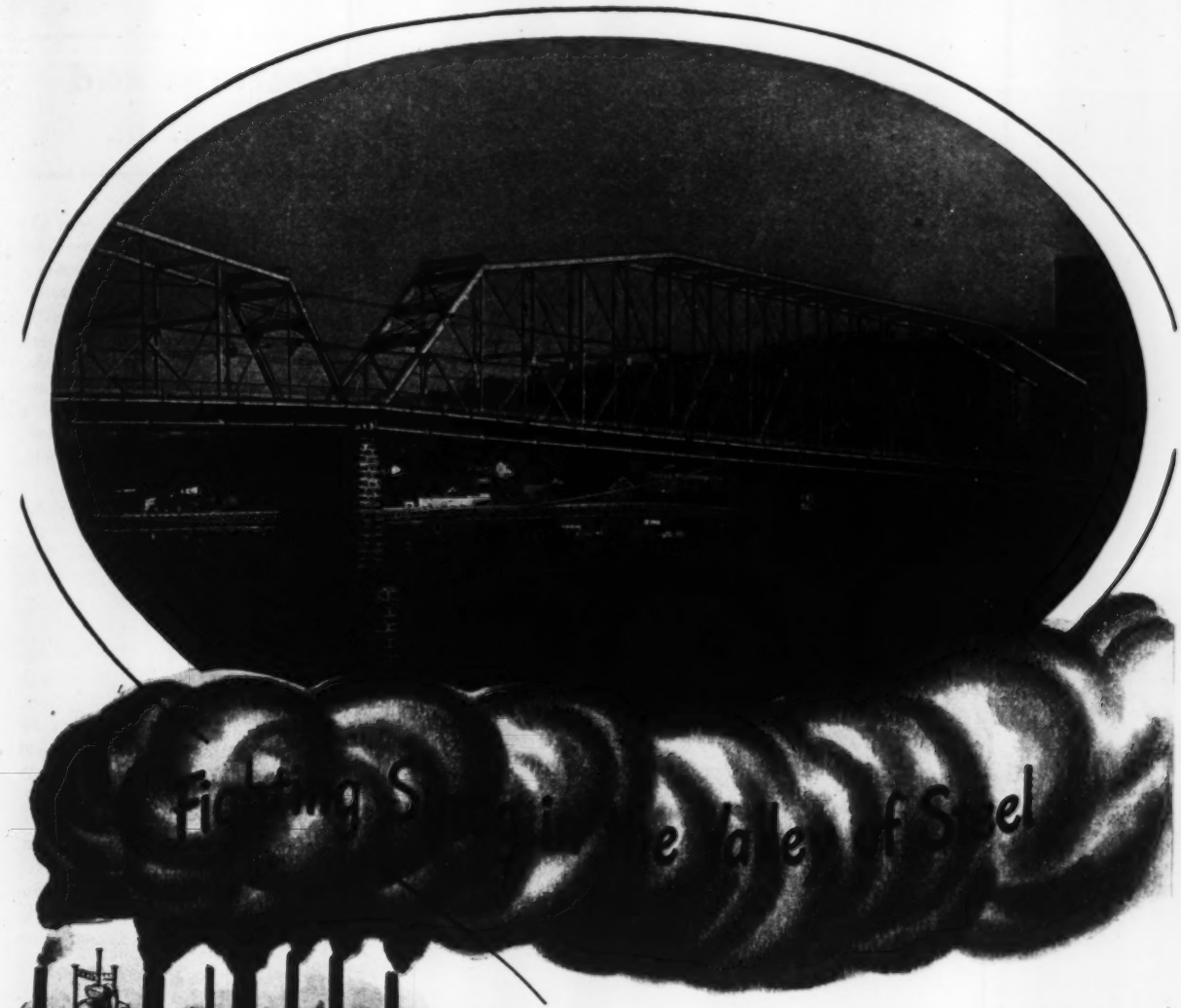
WILFRED C. OWEN has been named executive vice-president of Detroit Steel Products Co., Detroit, Mich., manufacturers of steel windows, building panels and automobile springs. Mr. Owen, who joined the company in 1914, has been successively assistant shop superintendent, shop superintendent, general factory manager, vice-president and director. He continues as a director of the company also.

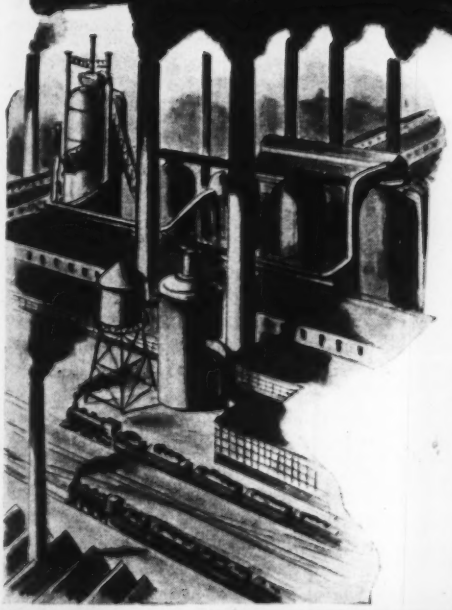
The company is gearing its production to help supply the demand for steel windows for lower-priced homes. The company before the war produced about half of the country's steel windows. It has streamlined its manufacturing and distributing facilities for greater volume.

WORTHINGTON PUMP AND MACHINERY CORP., Harrison, N. J., has appointed George E. Gates, for fifteen years prominent in western construction equipment industry, a staff member of the Worthington-Ransome Construction Equipment division, with headquarters at San Francisco, Calif.

SOULE EQUIPMENT CO., has moved into larger quarters on Ferry Street near Seventh in the Port of Oakland, Calif., area. According to Howard L. Stilley, general manager, the new site comprises about 5 acres, 31,950 sq. ft. of it under roof, with a direct spur track running into the property. The plant was recently vacated by Macco Construction Co., who have moved to Brisbane, Calif.

Soule Equipment Co. is Northern California distributor for LeTourneau, Bucyrus-Erie, Diamond Iron Works, Pioneer Electric, Graco lubrication equipment, American Rubber Co., and Briggs and Stratton engines.





In a 300-mile valley along the upper Ohio River and its tributaries, heavy industry rears thousands of smokestacks to the sky. Here paint requirements are exacting.

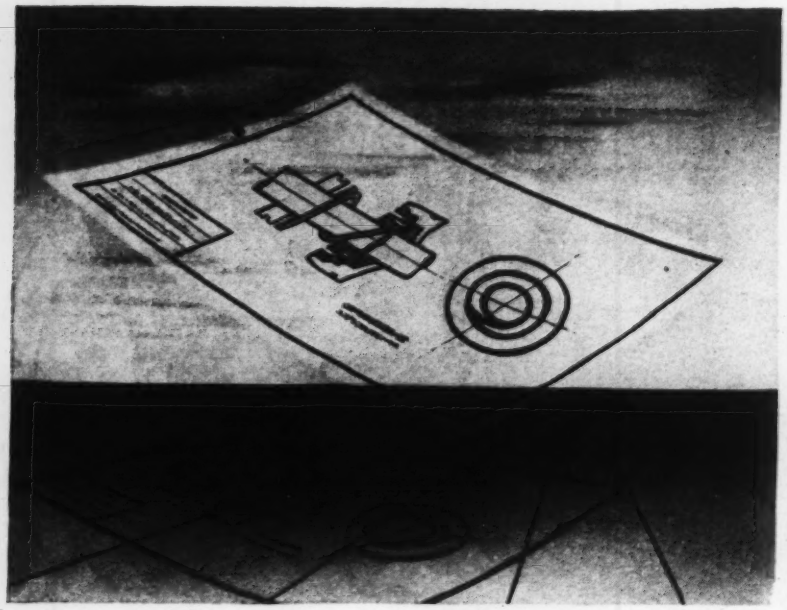
This bridge, for example, over the Ohio at Wheeling, West Virginia, is exposed to all of the ordinary enemies of paint—heat and cold, sun and rain, *plus* the corrosive "smog" that forms from the combination of atmospheric moisture and smoke. Highly sulfurous, this smog makes necessary the best resistance that a paint can give.

That is why the West Virginia State Road Commission primed this bridge with red lead, then followed with aluminum paint made with Alcoa Albron paste. The aluminum paint resists corrosion, looks well, provides high visibility, and gives maximum protection to the undercoat.

Wherever the enemies of paint get together in strongest force, that is the place to specify aluminum paint made with Alcoa Albron paste—uniformly high in quality; made from *99% plus* pure aluminum—for maximum protection. ALUMINUM COMPANY OF AMERICA, 1812 Gulf Building, Pittsburgh 19, Pennsylvania. Sales offices in principal cities.

ALCOA ALBRON PASTE

ALCOA ALUMINUM



As if suspended in air

Lines drawn on Arkwright Tracing Cloth stand out with such exquisite clarity that they almost seem suspended in air. This is due to the unusual transparency of the material that makes lines clear and sharp—without distortions due to pinholes, specks, dirt or stains.

Arkwright Tracing Cloths are preferred by experts because their transparency is obtained by special mechanical processing rather than by surface oils which may become opaque with age; because they sustain one erasure after another without wearing through; and because they take inking over erasures without feathering.

Prove to your own satisfaction that this combination of exclusive features makes for better prints. Write for free samples. Arkwright Finishing Company, Providence, R. I.

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TRACING CLOTHS

AMERICA'S STANDARD FOR OVER 20 YEARS

Elections and Activities

Dawson Winn, Laurel, Miss., who has been active in prefabrication for more than a decade, has been elected president of the Prefabricated Home Manufacturers' Institute. Other officers are: Austin Drewry, New Albany, Ind., vice-president; and John Pease, Cincinnati, Ohio, secretary-treasurer. W. Hamilton Crawford, Baton Rouge, La., was elected a director. James R. Price, Lafayette, Ind. and Mr. Winn were re-elected directors.

C. D. Martin has been elected president of the Halifax, N. S., branch of the Engineering Institute of Canada. The executive committee consists of: J. N. Ritchie, R. F. McAlpine, B. N. Cain, W. C. Risley, and E. C. Thomas.

W. C. Huntington, head of the Department of Civil Engineering at the University of Illinois, was a guest speaker recently at a dinner meeting of the Central Illinois Section of the American Society of Civil Engineers.

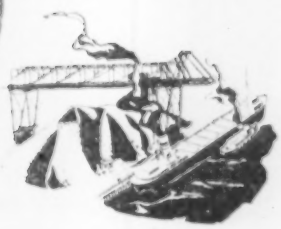
D. Mason Garber, of Winston-Salem, has been elected president of the North Carolina Section of the American Society of Civil Engineers. Robert E. Stienke, of Raleigh, was named vice-president.

One of the highlights of the recent annual meeting of the American Shore and Beach Preservation Association at Washington, D. C., was a technical description of the extensive work of the Beach Erosion Board during the war. This was a paper by Mrs. Clara S. Edmunda, associate geologist with the board, a division of the Army Engineer Corps. During the war two general types of reports were made by the board, a brief graphic report for strategic planning, and a fully detailed report for operational use. The first "Landing Area Report: Cherbourg to Dunkirk," was completed in July, 1942, almost two years before D-Day. The second study covered the beaches of French Morocco and Algeria and was used in planning the North African invasion in November, 1942.

Officers of the association reelected are: President, J. Spencer Smith, chairman of the New Jersey State Board of Commerce and Navigation; George Hjelte, Los Angeles, and Rear Admiral R. E. Bakenhus (retired), New York, vice-presidents; and Peter J. Gannon, Jersey City, N. J., secretary-treasurer.

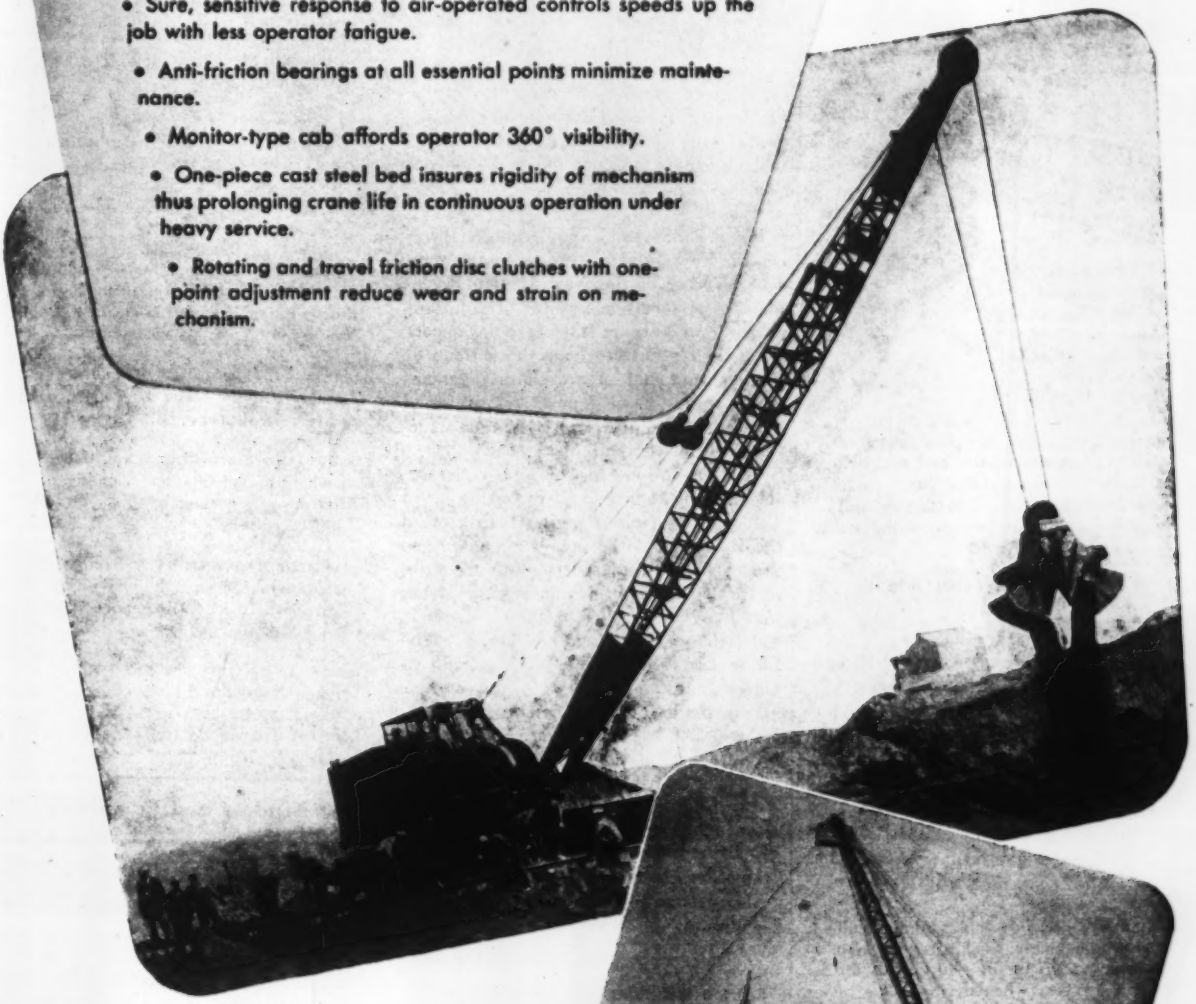
New directors elected were Brig. Gen. Warren Hannum (retired), head of the

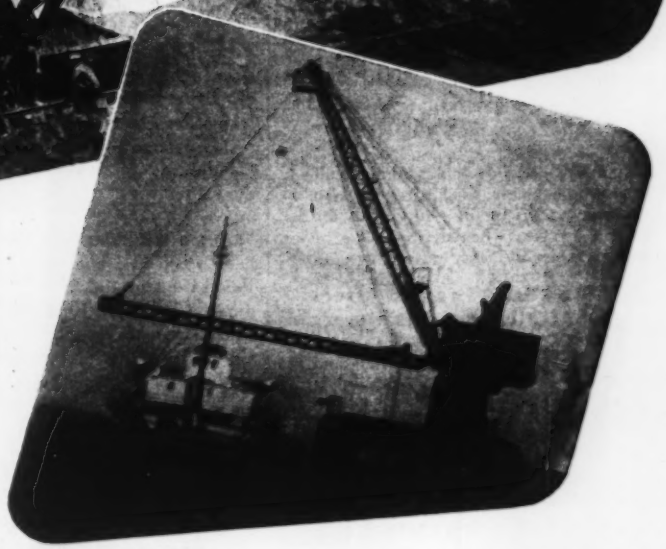
MOVE YOUR MATERIALS EASIER, FASTER, CHEAPER WITH I. B. EQUIPMENT



A few of the advantages offered by I.B. Locomotive Cranes include:

- Sure, sensitive response to air-operated controls speeds up the job with less operator fatigue.
- Anti-friction bearings at all essential points minimize maintenance.
- Monitor-type cab affords operator 360° visibility.
- One-piece cast steel bed insures rigidity of mechanism thus prolonging crane life in continuous operation under heavy service.
- Rotating and travel friction disc clutches with one-point adjustment reduce wear and strain on mechanism.

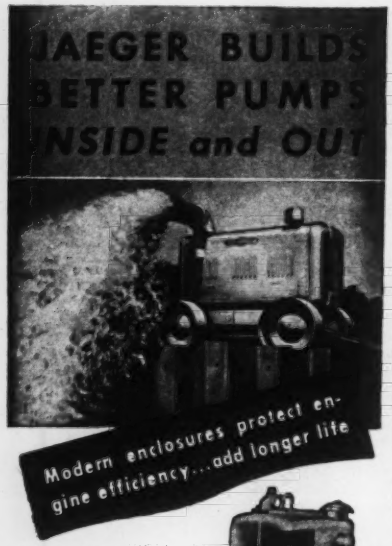


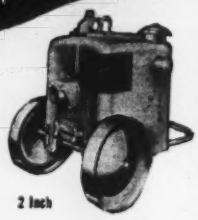


Advantages such as those listed above, engineered and built into I.B. Locomotive Cranes are typical of the design and construction superiority of all I.B. materials-handling equipment, including the electrically operated gantry crane pictured right. For the best possible answer to your materials-handling problems, talk things over with I.B.—first!

INDUSTRIAL BROWNHOIST BUILDS BETTER CRANES

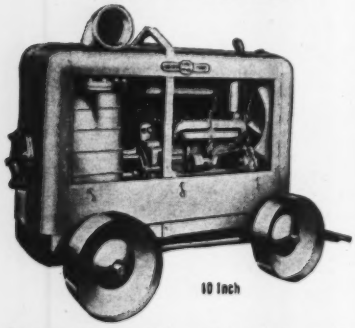
INDUSTRIAL BROWNHOIST CORP. • BAY CITY, MICH. • District Offices: New York, Philadelphia, Cleveland, Chicago • Agencies: Detroit, Birmingham, Houston, Denver, Los Angeles, San Francisco, Seattle, Vancouver, B.C., Winnipeg, Canadian Brownhoist Ltd., Montreal, Quebec.





Experienced contractors buy far more Jaeger "Sure Primes" than any other make of pump. They know that all "Sure Prime" pumps are better engineered, conservatively rated, powered with high grade engines and enclosed in modern housings that keep those engines dry, clean, quick-starting and smooth running for extra thousands of hours of low cost service.

Protected Yet Accessible



Instant opening side panels admit to all operating controls. Enclosures are also designed to lift off or swing open for complete access when desired. One of many exclusive Jaeger advantages.

Capacities 3000 to 240,000 g.p.h.

Only Jaeger Offers All These Features:

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new California state bureau in charge of beach preservation and development, and Charles H. Crandon, chairman of the Dade County board of supervisors, Miami, Fla.

At a recent meeting of the Florida section of the American Society of Civil Engineers, Arthur N. Solee, Duval County engineer, spoke on "Proposed Railway and Highway Connections Between the United States and South America." He discussed a proposed car ferry to operate from Jacksonville to the northern coast of South America, and the railroad and highway connections necessary to utilize the ferry service. He spoke of the possibilities of such a system, the problems to be surmounted, and touched upon its political aspects.

Flood danger and new irrigation projects in New Mexico were topics at a recent meeting of the New Mexico Reclamation Association where resolutions were adopted urging state agencies to continue their efforts to have the Bureau of Reclamation and other federal agencies make surveys and reports on proposed Rio Grande control and irrigation structures within the state.

The resolutions also urged such surveys for the Colorado River basin.

Wesley R. Nelson regional director of the Bureau told the members that measures for flood and sedimentation control of the Rio Grande are necessary, saying that flood danger to 70,000 residents in the Albuquerque area has been crucial for several years. This work as well as eleven additional projects for storage and diversion of water, would cost about $40,000,000, and have been recommended in a report on the middle Rio Grande prepared jointly by the Bureau and U. S. Army Engineers.

Some opposition to the proposed program was voiced by an Elephant Butte Irrigation District spokesman, who said residents in his area fear serious injury through reduction of their water supply if the structures are built.

Anton Hulman of Terre Haute has been re-elected chairman of the Indiana Flood Control and Water Resources Commission. Ralph Roessler was renamed vice-chairman. Staff members are:—Clyde R. Black, commission secretary; David H. Harker, chief engineer and C. C. Chambers consulting engineer.

J. P. McElroy will head the Engineers Club of Fresno, Calif., during the coming year. Other new officers are H. M. Patton, vice president, and R. E. Dunkle, secretary-treasurer. Elected directors were J. C. Heaslet, W. F. Kaiser, W. L. Scott, and C. F. White, J. P. Price, whom McElroy succeeds as president, also became a member of the board.

New Engineering Books

(*Continued from page 96*)

ANALYTIC GEOMETRY—Third Edition. Frederick S. Nowlan. 355 pp. McGraw-Hill Book Co., Inc., New York 18, N. Y. $2.75.

DESCRIPTIVE GEOMETRY—Earle F. Watts and John T. Rule. 301 pp. Prentice-Hall, New York 11, N. Y. $3.00.

BUILDING AN ENGINEERING CAREER—Second Edition. Clement C. Williams. 309 pp. McGraw-Hill Book Co., New York 18, N. Y. $2.50.

WATER BACTERIOLOGY—Sixth Edition. Samuel C. Prescott, Charles-Edward A. Winslow and Mac Harvey McGrady. 308 pp. John Wiley & Sons, New York 16, N. Y. $4.50.

REFRIGERATION APPLICATIONS—Second Edition. 190 pp. The American Society of Refrigerating Engineers, 40 West 40th St., New York, N. Y. $5.00.

BREAKING THE BUILDING BLOCKADE—Robert Lasch. 316 pp. The University of Chicago Press, Chicago, Ill. $3.

FIELD MANUAL OF SOIL ENGINEERING—Revised Edition. 304 pp. Michigan State Highway Department. Lansing, Mich. Limited edition.

STATICALLY INDETERMINATE STRUCTURES—L. C. Maugh. 338 pp. John Wiley & Sons, New York 16, and Chapman & Hall, London. $5.

DESIGN OF REINFORCED CONCRETE STRUCTURES—Second Edition. Dean Peabody, Jr. 532 pp. John Wiley & Sons, New York 16, and Chapman & Hall, London. $5.50.

Reports and Pamphlets

YOUR BUILDING CODE—Miles L. Colean. National Committee on Housing, 512 Fifth Ave, New York 18. 35c.

POSTWAR PLANNING CONFERENCE FOR CONTROLLED SURVEYING AND MAPPING—School of Engineering. Texas Engineering Experiment Station, College Station, Texas.

BEACH EROSION STUDY, OHIO SHORE LINE OF LAKE ERIE FROM OHIO-MICHIGAN STATE LINE TO MARBLEHEAD, OHIO—Document No. 177, House of Representatives. 79th Congress, 1st Session. Superintendent of Documents, Washington 25, D. C.

GROUND WATER SUPPLIES IN NORTHERN COOK AND NORTHERN DUPAGE COUNTIES—Bulletin No. 36. State Water Survey Division, Urbana, Illinois.

TECHNICAL FIELD DEVELOPMENTS AND RECOMMENDED REVISIONS IN STANDARD SPECIFICATIONS—Bulletin No. 30. American Public Works Association, Chicago 37, Ill. $1.00.

DURABILITY REQUIRED ...POZZOLITH USED

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The PROBLEM: To get durable concrete with the limited quality and grading of aggregates available at the remote location of this dam.

The SOLUTION: Pozzolith, Cement Dispersion.

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Many equipment manufacturers have found that "Industrial Gears" insure dependable performance, fewer field replacements, better customer satisfaction, longer operating life for the entire machine.

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MEN AND JOBS

Several changes have been announced in duties of engineers with the Washington State Highway Department. **Donald McMurray,** resident engineer at Port Angeles, has been promoted to district construction engineer at Olympia, his former post going to **Edward R. Smith** of Hoquiam. **Walter F. Winters,** who served in the Philippines during the war, attaining the rank of colonel, has been appointed district highway engineer at Vancouver. Before the war he had served successively as deputy Thurston County engineer at Olympia, Whatcom County engineer at Bellingham and Douglas County engineer at Waterville.

Claude Hershey, Jr., Effingham, has been employed recently as engineer aide for the Illinois Division of Highways.

Robert E. Willems, prominent in Akron, Ohio, district highway construction and maintenance for the last 20 years, has been named head of that city's highway maintenance and sanitation division, succeeding **Donald G. Cackler,** who resigned to join an Akron construction firm. Willems had served earlier as assistant city highway engineer, leaving that post to take care of District 12 for the Ohio highway department, where he served four years. Willems also was deputy county engineer under H. G. Sours.

William D. Colby, Chatham, Ont., has been named engineer for the Township of Dunwich, Elgin County, Ont.

Murray A. Stewart, principal engineer of the Department of Public Works, Toronto, Ont., has been named deputy city engineer.

George J. Ray has retired as vice-president of operations of the Delaware, Lackawanna & Western Railroad. He is a graduate of the University of Illinois and took his C.E. degree at Lafayette College in 1910 and a D.Sc. from the same college in 1916. In 1898 he started as a rodman in the engineering department of the Illinois Central. He was first employed by the Lackawanna in 1903 as division engineer at Scranton, Pa., and in 1909 he was promoted to chief engineer at Hoboken, N. J.

Mr. Ray had charge of several notable engineering projects, one of which, the low-grade cut-off across northern New Jersey, which included the Pequest fill, largest railroad embankment in the world; and another project, the Lackawanna's cut-off between Clark's Summit, Pa., and Halstead, west of Scranton, included the construction of Tunkhannock viaduct, the world's largest concrete railroad bridge, 2,375 ft. long, and 240 ft. high. Mr. Ray became vice-president of the D. L. & W. in 1934.

Guy E. Griffin is the newly appointed associate chief of field party and chief engineer in Honduras for the Institute of Inter-American Affairs. Mr. Griffin received a B.S. degree in civil engineering from the University of Maine and a M.S. degree from Harvard University in sanitary and municipal engineering.

He has just finished four and a half years in the Army Engineer Corps, having spent eight months overseas assisting in the supervision of the rehabilitation of water and sewerage systems in areas where damage to systems had been done by bombs and shell-fire. His previous experience included 10 years as sanitary engineer for Greenwich, Conn., six years with Metcalf and Eddy, consulting engineers in Boston; and a few months with the Massachusetts State Health Department.

Braxton T. Branch, of Oxford, N. C., sanitary inspector for Granville County, has been appointed sanitary engineer with the Veterans Administration, at Richmond, Va.

The engineering firm of **Dodson & Eason** has been started at Ephrata, Wash., by **James H. Dodson,** Grant County engineer, and **Stearns Eason,** a former Seabee with nine years of engineering experience.

The Portland, Ore., firm of Stevens & Koon, consulting engineers, has been expanded to include **J. C. Gearhart** and **H. L. Thompson,** civil engineers. A 1935 graduate of Oregon State College, Gearhart has been associated with Stevens & Koon since 1936. He recently returned from the Navy, where he served as a lieutenant in the Civil Engineering Corps. Thompson served on the civil engineering faculty at Northwestern Technology Institute and also taught at the University of Idaho.

Morris M. Cohn, sanitary engineer of Schenectady, N. Y., and editor of *Sewage Works Engineering,* has been appointed adviser-at-large to the state of Vermont in stream pollution abatement.

F. Linnau, city engineer of Wauwatosa, Wis., since 1937, has resigned to enter the construction business.

Manufacturers' Publications

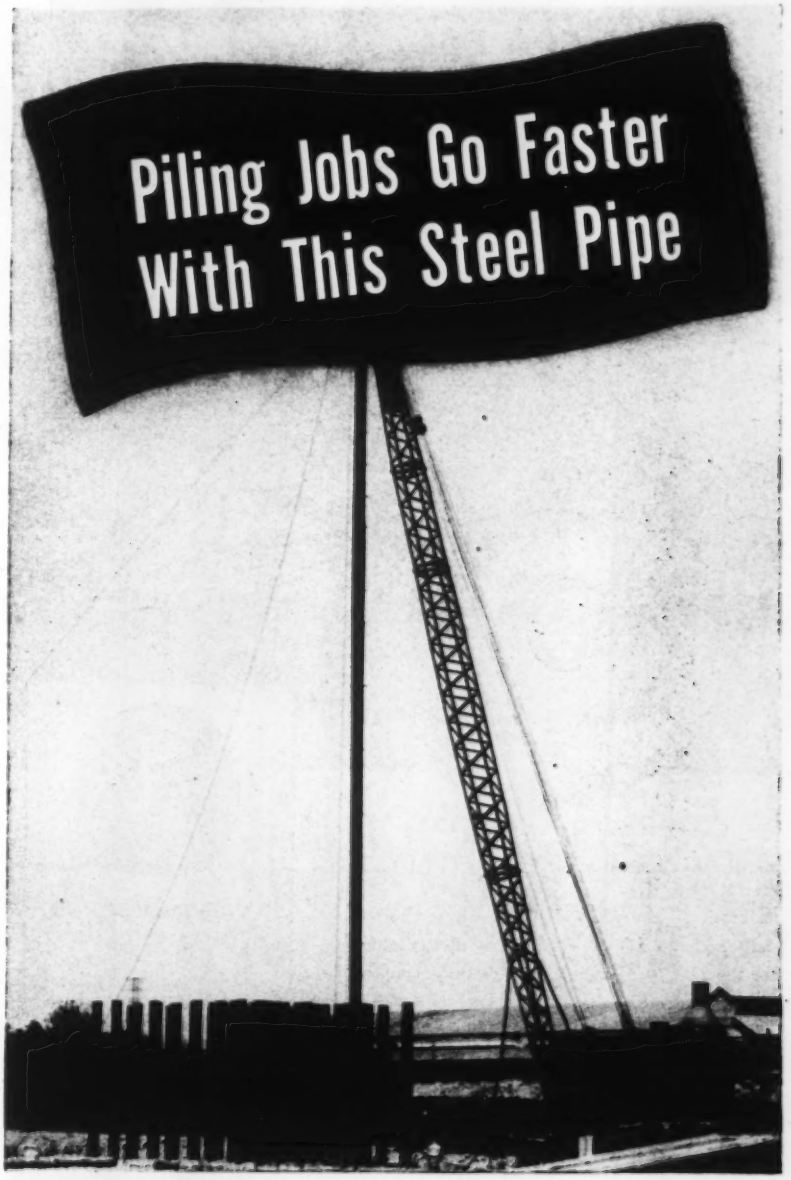
Concrete Curing—A 16-page catalog of paving products is supplemented by a 4-page folder of standard specifications for testing a concrete curing compound, covering such points as viscosity, durability, color, adherence, chemical action, moisture, retention, application, non-volatile material, and flash point of solvent.—*Keystone Asphalt Products Co., 43 East Ohio Street, Chicago, Ill.*

Soil Stabilization—An unusually fine 86-page book has been prepared on soil stabilization methods. It defines "soil stabilization" as the preparation and consolidation of all types of sub-base, base and surfaces employing combinations of natural and processed aggregates, although the construction trade limits the term to those natural materials found on or near the site of operations—sands, clays, and finer graded gravels. This publication is really a text-book, and an excellent one, for every constructor.—*Seaman Motors, Milwaukee, Wis.*

Pond Building—A profitable "slack time" use for construction equipment is described in this booklet about pond building for stock water, erosion and flood control, recreation, and other purposes. The construction of farm dams is an earthmoving job, as it is heavy work in substrata not normally handled by farm machines. It requires earth digging, transporting, placing and compacting. It may call for the shuttling capabilities of a bulldozer, the easy hauling of the rotary scraper, the capacity, transporting and compacting qualities of the carry-type scraper on longer hauls. And power and traction must be linked with economy of operation. These facts are all brought out in this new publication.—*Caterpillar Tractor Co., Peoria, Ill.*

Roofing and Siding—An illustrated circular describes an alloy-steel, electrostatically-coated roofing and siding material. Toughness, immunity to atmospheric corrosion or chemical attack, and high fire resistance are stated merits of the material.—*Reliance Steel Products Co., McKeesport, Pa.*

Sanitation Equipment—A complete line of sanitation and liquid clarification equipment is presented in a 44-page book. Products illustrated and described include conveyor sludge collectors and removers, grit collectors and washers,



You can keep right on schedule and do a more efficient job when you use ARMCO Spiral Welded Piling for your foundation work.

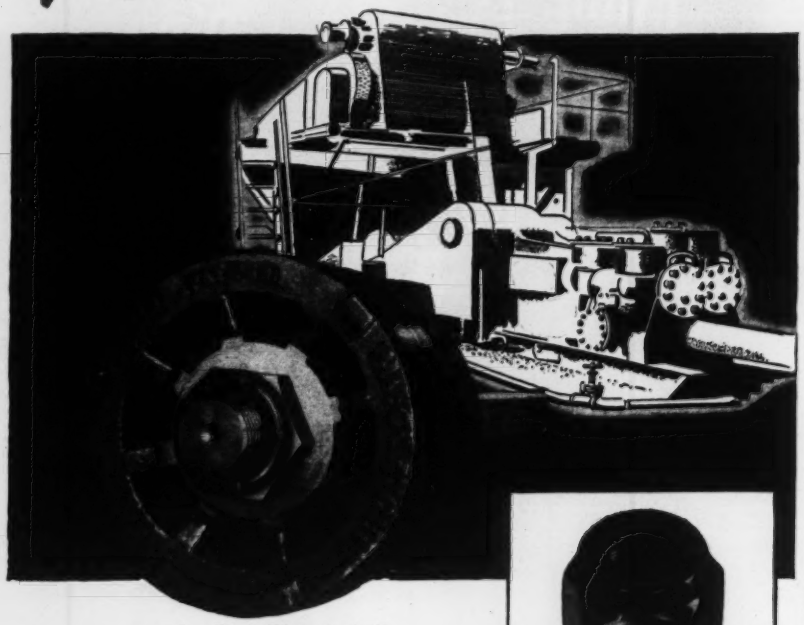
These piles drive *straight* and *fast* with the least time and effort. The tough spiral weld imparts extra lateral stiffness and high collapse-resistance to even the longest lengths. Yet ARMCO Foundation Piles are relatively light, which makes for quick, easy handling. And you can save driving time by specifying long lengths.

For greatest economy specify the exact wall thickness you need. Diameters range from 6 to 36 inches, wall thicknesses from 3/16 to ½-inch. When you need end plates, cone points, or cutting shoes, these can be mill-attached. Ask us for a quotation on your next foundation job. Just address Armco Drainage & Metal Products, Inc., 605 Curtis Street, Middletown, Ohio.

ARMCO

ARMCO FOUNDATION PILES

2,500 PSI *Reciprocating Action* ON SLUSH PUMPS



— yet the Red Elastic Collar protects permanently against VIBRATION

Vibration — caused by alternate suction and pressure that reached 2,500 psi — made complex trouble spots for the 1½" to 2" nuts that held slush pump pistons on the rod. Other types of *conventional* fasteners failed. ESNA Elastic Stop Nuts held permanently!

In addition to holding permanently against Vibration, ESNA Elastic Stop Nuts protected against Liquid Seepage. Abrasive mud could not get between the nut and rod to cut out the piston and core rod. They prevented Thread Corrosion. They prevented Costly Maintenance during piston replacement because they are self-lōcking, easily removable, and reusable over and over.

Here's a challenge: Send us complete details of your toughest bolted trouble spot. We'll supply test nuts — FREE, in experimental quantities. For further information or literature address: Elastic Stop Nut Corporation of America, Union, New Jersey. Representatives and Agents are located in principal cities.

The RED ELASTIC COLLAR
—denoting an ESNA product

. . . is threadless and permanently elastic. Every bolt — *regardless of commercial tolerances* — impresses (does not cut) its full thread contact in the Red Elastic Collar to fully grip the bolt threads. In addition, this threading action properly seats the metal threads — and eliminates all axial play between bolt and nut threads.

All ESNA Elastic Stop Nuts — *regardless of size or type* — lock in position anywhere on a bolt or stud. Vibration, impact or stress reversal cannot disturb prestressed or positioned settings.

ESNA

ELASTIC STOP NUTS

INTERNAL WRENCHING · ANCHOR · INSTRUMENT MOUNTING · SPLINE · CLINCH · GANG CHANNEL

***PRODUCTS OF* ELASTIC STOP NUT CORPORATION OF AMERICA**

thickeners, skimmers, aero-filters, rapid mixers, gravity waste water-oil separators, and water screens.—*Chain Belt Co., 1600 West Bruce Street, Milwaukee 1, Wis.*

Horizontal Drill—A circular tells of a 2-speed mechanical feed horizontal drill with traction drive. The drill is equipped with a complete mechanical feed both for drilling and retrieving. Two speeds are incorporated in the feed transmission and gearing: the first, a drilling speed of two to three feet a minute and the second a retrieving speed of 24 ft. a minute.—*Paris Manufacturing Co., Paris, Ill.*

Portable Air Hoist—A bulletin features a new portable air hoist, designed for lifting jobs in the ¼- and ½-ton capacity range. It weighs only 30 pounds, but has a lifting capacity of 1000 pounds at 17 ft. per minute and proportionately greater speeds for lesser loads. Explained are variable speed and built-in safety features. Engineering data are also given.—*Keller Tool Co., Grand Haven, Mich.*

Indestructible Lubricant—A bulletin tells of a lubricant developed for new production methods using increased speeds, greater pressures and high heat conditions. The manufacturer claims for the product that it adheres to metal surfaces, thoroughly wetting them and preventing creepage and wiping action under very high pressures. It is also water repellent, is not easily emulsified, and retains its stability in service and in storage.—*Brooks Oil Co., 315 E. Carson St., Pittsburgh 19, Pa.*

3-Wheel Rollers—A new 16-page catalog describes 10-ton and 12-ton 3-wheel rollers. Illustrations show clearly the unit assembly of engine, transmission, differential, clutches, and final drive pinions; the top air intake; 4-speed transmission and other elements of design. Specifications are included.—*Buffalo-Springfield Roller Co., Springfield, Ohio.*

Gas Drive Welder—A 48-page book entitled "How To Build Your Own Gas Drive Welder," gives actual photographs, plans and ideas.—*The Hobart Brothers Co., Troy 1, Ohio.*

Catalogs Wanted—Catalogs of materials and equipment from manufacturers and jobbers covering general building construction, electrical, heating, ventilating, plumbing, refrigeration, air-conditioning, outside utilities, waterworks, and sewerage are wanted by—*The Veterans Administration Construction Service, Branch Office No. 4, 900 N. Lombardy St., Richmond, Va.*